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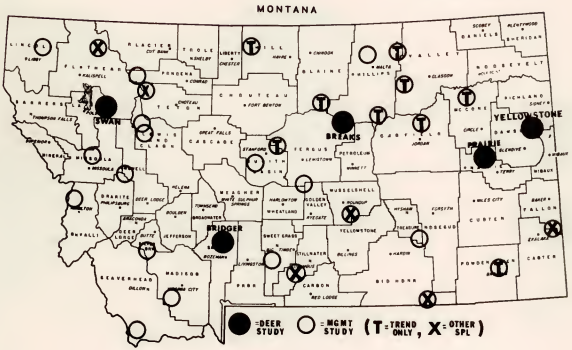

Montana Department of Fish, Wildlife and Parks
Federal Aid Project W-120-R-12

Progress Report for the Period
July 1, 1980 - June 30, 1981

NOV 11 '81

JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

STATE	Montana		
PROJECT	W-120-R-12	NAME	Statewide Wildlife Research
STUDY NO.	BG-1.0	TITLE	Statewide Mule Deer Ecology Studies
JOB NOS.	1 and 2	TITLES	(Various)
STUDY NO.	BG-2.0	TITLE	Statewide White-tailed Deer Ecology Studies
JOB NOS.	1, 3, and 5	TITLES	(Various)

Period Covered: July 1, 1980 - June 30, 1981

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INTRODUCTION

The statewide deer research program was initiated in July 1975. Background information on problems and needs was given in previous reports (Mackie et al. 1976, 1977, 1978, 1979, 1980). Overall objectives were to:

1. provide a more detailed understanding of the population biology and habitat relationships of deer and of the factors influencing deer numbers in the diverse environments in which deer occur in Montana;

2. develop new or improved methods for measuring deer population and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs; and

3. establish new guidelines for consideration of the habitat requirements and relationships of deer in other game range, forest, and land management programs and practices in Montana.

The approach entailed concurrent, comparative investigations on the population ecology and habitat relationships of mule and white-tailed deer over several years on areas representative of the major ecological or "habitat" types on which the two species occur in Montana. Such studies appeared to provide the best opportunity to determine the normal range of population characteristics and behavior in natural populations and the relative importance of various "limiting" factors in population regulation over a wide range of habitat and environmental conditions. Thus, they should also provide the framework for understanding the process(es) of regulation in deer populations generally as well as the roles and importance of both intrinsic and extrinsic factors.

During the first 5-year segment emphasis was directed to those areas and "habitats" in which problems or research needs and/or the opportunity to achieve basic, overall study objectives was greatest. These included studies of mule deer in the mountain-foothill habitat of southwestern Montana, the timbered "breaks" in northcentral Montana, and the open plains-prairie type in eastern Montana. For whitetails, they included the coniferous forest habitat of northwestern Montana and the major river bottomland and prairie-agricultural habitats of central and eastern Montana. Most intensive efforts were in the mountain-foothill, breaks, and coniferous forest types. A general discussion of major findings, management implications, and recommendations resulting from those efforts was presented in the 1980 Deer Studies Progress Report (Mackie et al. 1980). Numerous separate publications and reports have also summarized findings and other information resulting from the studies. These include:

Hamlin, K. L. 1977. Population dynamics and habitat relationships of mule deer in the Bridger Mountains, Montana. 1955-76. Ann. Conf. N.W. Section, TWS, Kalispell, MT., Feb. 1977.

_____. 1978. Deer, coyote and alternate prey relations in the Missouri River Breaks Montana. Ann. Conf. N.W. Section, TWS, Portland, OR., Feb. 1979.

_____. and L. Schweitzer. 1979. Cooperation by coyote pairs attacking mule deer fawns. J. Mamm. 78(4): 849-850.

_____., R.J. Mackie, J.G. Mundinger, and D.F. Pac. *In press.* Effect of capture and marking on subsequent fawn production in deer. J. Wildl. Manage.

Mackie, R.J. 1976. Interspecific competition between mule deer, other game animals and livestock. Pages 49-54 *in* mule deer decline in the west. A Symposium. Utah State Univ. Coll. of Nat. Resour., Agr. Exp. Sta., Logan.

_____. 1978. Natural regulation of mule deer populations. *In:* Natural regulation of Wildlife. ed. D.S. Eastman and F. L. Bunnell. Academic Press, New York. *In press.*

_____. 1979. "Competition" and the future of wild ungulates on Montana rangelands. Joint meeting of the Mont. Chapters Soil Cons. Soc. of Amer., Amer. Fisheries Soc., Soc. Amer. Foresters and The Wildlife Society, Missoula, MT. Jan. 31-Feb. 1, 1979.

_____. 1981. Interspecific Relationships. Chapter 13 *in* O.C. Wallmo, ed. Mule and Black-tailed Deer of North America. Univ. of Nebraska Press. 605 pp.

_____. K. L. Hamlin, and D. F. Pac. 1980. Census methods for mule deer. *In:* Census and inventory methods for populations and habitats, 1980 Symp. N.W. Section of the Wildlife Society, Banff, Alberta . *In press.*

_____, _____, and _____. *In press.* The mule deer. Chapter 44. *In:* Game, Pest and Furbearing Mammals of North America. J. A. Chapman (ed.) J. Hopkins Univ. Press.

_____, and D. F. Pac, 1980. Deer and subdivisions in the Bridger Mountains, Montana. Proc. West Assoc. of State Fish and Wildlife Agencies 60:517-526.

Mundinger, J. G. 1979. The Swan Valley: whitetail country, Mont. Outdoors 10(5): 35-41.

_____, 1981. White-tailed deer reproductive biology in the Swan Valley, Montana. J. Wildl. Manage. 45(1):132-139.

_____, 1981. Impacts of timber harvest on white-tailed deer in the coniferous forests of northwestern Montana. Ann. Conf. N.W. Section, T.W.S., Cour d'Alene, ID. April 1981.

Pac, D.F. and R. J. Mackie. 1981. Conflict for space. Montana Outdoors 12(2):13-16.

Schladweiler, P. 1981. Coyotes and big game. Montana Outdoors 12(2):17-20, 29.

Collectively, the findings to date have indicated that occupancy of different habitats in the northern Rocky Mountains and Great Plains by deer is accompanied by broad differences in deer behavior (range use, etc.), biology (body size and condition, longevity, reproduction, etc.), and population size or density and dynamics. These differences apparently reflect the nature and inherent characteristics of available habitats and the manner in which deer interact with and respond or adapt to the total environmental complex in which each population occurs. The broader the difference in habitat, the greater the difference in population parameters and dynamics. From this, Mackie (1978) and Mackie et al. (1980) concluded that differences in behavioral, biological, and population characteristics and population dynamics both represent and reflect the strategy by which deer occupy and maintain themselves over time in a given habitat or environment. These findings hold several important implications for deer management and future research; for example:

1. Traditional interpretations of dynamics and population regulation in deer in terms of forage carrying capacity, especially the supply of important or "key" forage plants (browse) on winter range, may not be valid or generally applicable. In context of the above findings, the relevant habitat of deer is the total environment in which they occur yearlong; and regulation appears to occur as a result of interaction between inherent characteristics of that habitat and inherent requirements and behavioral attributes of the animals. Those interactions determine the particular "strategies" required and expressed within individual habitats and populations. Ultimately, they also determine both "fill" (the relative numbers or density of deer a given habitat can hold or sustain) and "turnover" (the primary process through which regulation is expressed).

2. Because no two habitats or environments occupied by deer will be exactly alike, each will entail deer-habitat interactions that effect different strategies, population phenomena, and dynamics. It follows that environmental changes that alter the nature or characteristics of a given habitat or its resource outputs over time could be expected to effect changes in those interactions such that strategies, population phenomena, and dynamics would also change. When environments and interactions change slowly (e.g., as a result of plant succession), deer may gradually adapt (i.e., evolve different strategies) such that changes in behavioral, biological, and population characteristics and dynamics could be subtle and scarcely perceptible except as long-term differences. On the other hand, where sudden and drastic changes in environmental conditions (e.g., general changes in land use) cause extensive changes in the nature of a habitat, existing interactions and habitat relationships might be greatly disrupted. If deer were to survive or subsequently reoccupy that habitat, very different strategies and population phenomena and dynamics would be expected.

3. It should also follow that management or other judgements or generalizations about the relative "quality" of different habitats, their ability to support or produce deer or to sustain hunting, the role and importance of various environmental or "limiting" factors, the impacts of various land uses and management practices or environmental changes, and management needs or opportunities could be extremely misleading without some specific

knowledge of basic deer-habitat relationships and the strategies deer follow in each habitat. Thus, it would appear that all management, research, and environmental assessment efforts should place much greater emphasis on individual populations and their habitats. All population-habitat units involved should be defined and characterized as a basic part of any such effort, and each should be considered separately.

4. Because differences in behavioral, biological, and population characteristics and population dynamics appear to be consistent, at least within a "normal range" for each habitat, they may be diagnostic of basic deer-habitat relationships and how well or the extent to which each meets the requirements of deer. Thus, they should also be indicative of the potential of a given habitat to support or produce deer, the ability of a population to sustain hunting and required harvest strategies, the relative importance of various environmental factors and influences, and management opportunities and constraints. This would enable habitat-population units of similar characteristics and potential to be grouped together for general management purposes. At the same time, it could also provide basis for assessing management significance, establishing priorities for further management attention, and developing specific management strategies for each unit or for groups of units.

5. If the observed relationships can be substantiated with additional data from studies conducted in all or most of the habitats occupied, it may be possible to develop a "model" that relates deer population phenomena and dynamics to basic habitat/environmental features and characteristics across the spectrum of habitat types available to deer in the northern Rocky Mountains and Great Plains. This model could serve as a framework for correct interpretation of habitat and population data and habitat relationships of deer within all habitats in the spectrum. It might also provide basis for predicting population phenomena from habitat/environmental features and habitat characteristics and relationships from population data.

Present efforts continue most of the basic studies established during 1975-76, except those on deer in the prairie-agricultural habitats of eastern Montana. In addition, an intensive study of white-tailed deer on river bottom habitats along the lower Yellowstone River was established during the summer of 1980. Goals and objectives are generally similar to those outlined earlier, except that greater emphasis is now given to testing hypotheses developed from investigations and findings during the 1975-1980 period. Specifically, they are to:

1. further determine basic biological and ecological parameters for mule deer and white-tailed deer in populations associated with the major habitats in which the two species occur in Montana. These include population size/density, reproduction/recruitment, mortality/turnover, sex/age structure, longevity, and physical condition. They also include distribution, movements, use of specific habitat/cover types, food habits, and other behavioral patterns;

2. further relate those basic biological and ecological parameters to characteristics of individual habitats or environments, including topography, physiography, vegetation, weather and climate, and land use, as well as to specific potential limiting factors associated with individual habitats, study areas and populations. Those might include nutrition (forage production, availability, and quality), other wild ungulates, domestic livestock, livestock grazing and associated range management practices, logging and associated forest management practices, agriculture and associated cropping practices, and rural subdivisions and associated human activities. They could also include hunting, predation, diseases and parasites, and weather;

3. further develop and test hypotheses relating to findings outlined above; particularly that: natural population regulation in deer is basically effected by interaction between inherent habitat characteristics and inherent requirements and behavioral attributes of the animals; that population phenomena and dynamics are the strategy by which deer populations exploit diverse habitats; and that population dynamics are indicators of basic habitat relationships of deer in the diverse habitats in which they occur; and

4. develop new methods, criteria, and guidelines for deer management including those for: assessing mule deer and white-tailed deer population characteristics in major habitats, assessing important habitat/environmental characteristics; relating population phenomena and dynamics of the two species to habitat/environmental characteristics, and vice-versa; relating population phenomena and dynamics to specific management opportunities or constraints; relating important habitat/environmental characteristics to specific management opportunities and constraints; measuring and/or interpreting the role and importance of various "limiting factors" in deer management programs; and for consideration of the requirements and habitat relationships of deer in other land use and management programs.

This report compiles Job Progress Reports for individual jobs and investigations conducted on intensive study areas or in conjunction with the Statewide Deer Research Studies during 1980-81. The individual reports outline specific job objectives and procedures and present and discuss current findings in relation to information obtained previously.

STUDY NO. BG-1.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of mule deer in mountain-foothill habitats in southwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of mule deer in the Bridger Mountains were continued during 1980-81. The winter of 1980-81 was the mildest since the study began. Vegetation cover types were mapped and the area of each type was estimated for the Northwest Slope and Brackett Creek year-long ranges. Timbered types occupied 78% of the Northwest Slope and 44% of the Brackett Creek range. Much of the non-timbered area is suitable winter range on Brackett Creek while much of the non-timbered cover types on the Northwest Slope are above timberline. At the end of April, 92 deer with recognizable neckbands and/or radio-collars were present on the Armstrong study area, while 60 marked animals occurred on Brackett Creek. Approximately 63 deer wore recognizable collars on the Battle Ridge winter range. Population data for the Armstrong winter range indicated that 188 mule deer were present in early winter; the number decreasing to 170 by spring. Overwinter fawn mortality was light with the estimated total reaching about 22% of early winter numbers while confirmed adult mortality was limited to two males and one old female. Observed ratios from winter aerial classifications were 69 fawns: 100 females, 57 fawns: 100 adults and 19 males: 100 females in early winter and 55 fawns: 100 adults in late winter. The spring fawn:female ratio was 54:100, the highest since the study began. During the 1980 hunting season, an estimated 320 (64%) of 500 either sex permit holders hunted deer in HD 312 and 180 killed deer. Hunter success was 56% compared to 41% in 1979. Calculations based on helicopter sampling efficiencies and the total number observed during the late winter surveys indicated a population of 8,620 mule deer for the entire Bridger Range.

JOB TITLE: Population ecology and habitat relationships of mule deer in mountain-foothill habitats in southwestern Montana.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with mountain-foothill habitats;
2. To relate those basic population parameters to (a) characteristics of individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, logging and forest management practices, subdivisions and associated human activity, weather, and hunting;
3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and
4. To develop new methods, criteria, and guidelines for deer management, generally, and, specifically, for mountain-foothill habitats.

INTRODUCTION

This report summarizes findings of studies on the population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana, for the period 1 July 1980 through 30 June 1981. These studies have been conducted continuously since the winter of 1971-72 following two broadly different approaches: (1) intensive studies of the distribution, movements, habitat use and population characteristics of mule deer associated with specific winter ranges, and (2) extensive studies of the seasonal distribution, habitat relations and population characteristics of mule deer throughout the Bridger Mountain Range complex. The history and general nature of both efforts were described by Mackie et al. (1978). An abstract of the final thesis report of intensive studies on mule deer associated with the Brackett Creek range (Rosgaard 1981) is presented separately.

THE STUDY AREA

The Bridger Mountain Range (Fig. 1) is located in northeastern Gallatin and northwestern Park Counties, Montana. A detailed description of topographic, climatic and vegetational characteristics of this area, including the location of major mule deer winter ranges and associated seasonal ranges was presented previously (Mackie et al. 1978, 1979, 1980).

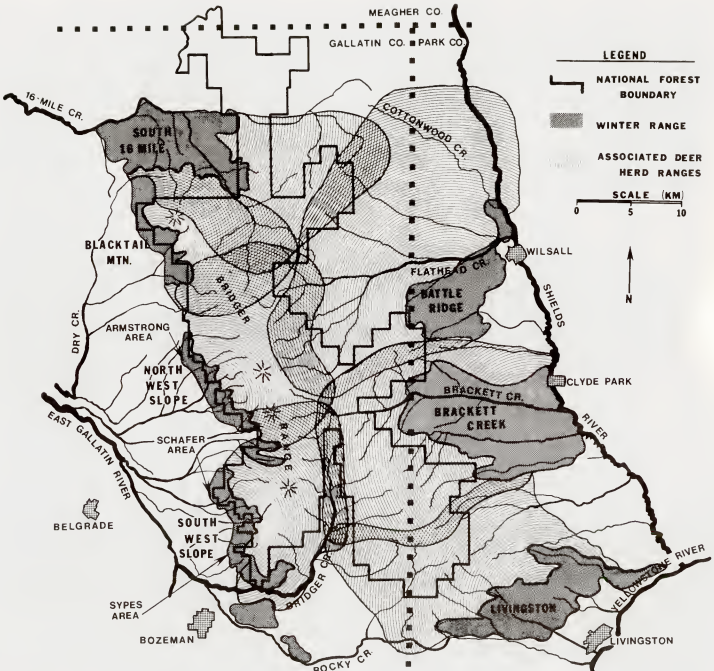


Figure 1. Map of the Bridger Range showing major features and the location of primary study areas.

METHODS

Habitat Analysis

Habitat parameters measured and general methodology employed were described by Mackie et al. (1978).

During 1980-81, emphasis was placed on (1) obtaining basic weather data on four of the mule deer winter ranges; (2) continuing cover and habitat type delineation and mapping of the Armstrong and Brackett Creek mule deer ranges; and (3) comparing those ranges on the basis of important environmental variables.

Population Studies

Various methods employed in assessment of deer population characteristics have been described in detail in previous reports (Mackie et al. 1978, 1979). During 1980-81, early winter helicopter surveys (Mackie, Hamlin and Pac 1980) were conducted on 8-9 January 1981 on the Armstrong and Brackett Creek study areas. In late winter, all major mule deer winter ranges in the Bridger complex, excluding North-16 mile, were surveyed on 19-20 March 1981. The Brackett Creek winter range was also surveyed using a Piper Super-cub on 3 February and 11 April 1981. A separate estimate of mule deer numbers on the Armstrong winter range in late winter was developed from ground observations on 8 days during April when a minimum of 50 deer were recorded per survey.

Eleven additional deer were marked with "Armortite" neckbands by bait trapping on the Armstrong winter range from 26 January to 13 February 1981. A summary of all mule deer tagged on the area from 1972 through 1981 and their status as of May 1981 is given in Table 1. At the end of May, 1981, 10 of the Armstrong deer wore functional radio-collars.

Table 1. Summary of mule deer trapped on the Armstrong winter range from 1972 through 1981 and their status as of May 1, 1981.

YEAR	TOTAL NO. MARKED	NO. OK[1] 5/81	NO. DEAD[2]	UNKNOWN
1972	5	0	4(3)	1
1973	16	1	11(1)	4
1974	39	8	14(3)	17
1975	36	7	22(9)	7
1976	9	3	3(1)	3
1977	16	10	5(2)	1
1978	42	19	12(4)	11
1979	72	26	22(4)	24
1980	24	11	9(2)	4
1981	11	9	0	2

[1]Number alive during spring, 1981. Includes one female and one male that wintered off the study area.

[2]Number shot by hunters in parentheses.

In early March 1981, 63 additional mule deer were trapped on the Battle Ridge winter range using a drive net and helicopter (Beasom et al. 1980). Eleven adult females were fitted with transmitter collars, the remainder of those deer were neckbanded.

Information on hunter success, hunter distribution, and the total number, sex and age structure and distribution of the deer harvest during 1980 was determined from a mail questionnaire sent to all 500 special either-sex permit holders for HD 312, which includes the Bridger Range.

RESULTS AND DISCUSSION

Habitat Studies

Weather Conditions on Major Winter Ranges

The winter of 1980-81 was the mildest overall since 1971 (Table 2) and probably was one of the mildest ever recorded at the M.S.U. (Bozeman) weather station. Temperatures at Bozeman averaged more than 5°F above the 20-year mean for November-May, and there was no period of unusual cold.

Table 2. Climatological data, MSU Weather Station, Bozeman, and severity indices[1], 1971-1981, November through May.

	Avg. Temp. (°F)	Ppt. (In.)	Total Snowfall (In.)	Max.Snow Depth (In.)	No.Days Snow on Ground	Severity[1] Index
1971-72	33.9	7.7	81.8	10	119	- 329
1972-73	31.3	8.4	92.6	14	135	+1335
1973-74	34.3	10.0	89.9	14	116	+2025
1974-75	30.5	12.1	118.6	17	161	+2286
1975-76	35.2	9.9	95.2	12	86	- 810
1976-77	37.4	7.9	57.8	9	88	-2391
1977-78	33.9	10.0	60.5	12	111	+ 790
1978-79	29.9	10.7	87.4	18	159	+7843
1979-80	33.3	10.9	100.7	20	144	+ 752
1980-81	37.6	12.9	55.6	8	74	-2871
20 Year Mean	32.4	9.5	84.01[2]	13.4[2]	119[2]	+ 863[2]

[1]Method of computation from Picton and Knight (1969). Positive values indicate greater severity.

[2]10-year mean.

Snow depth and the relative proportion of the area covered by snow on each winter range was less than recorded during either of the preceeding two winters (Table 3). Also, the percentage of measuring dates on which a measurable amount of snow occurred on the ground was lowest in 1980-81.

Table 3. Snow coverage and depths compared for four mule deer winter ranges in the Bridger Mountains, 1978-1981.

	Armstrong	Blacktail Mountain	Brackett Creek		Livingston
			Leffingwell	Peckenpaugh	
Percent of measuring dates with snow on ground					
1978-79[1]	73	100	67	ND	40
1979-80[3]	73	73	70	79	48
1980-81[3]	52	52	52	42	39
Mean percent snow coverage per measurement					
1978-79[1]	78	85	76	ND	63
1979-80[3]	54	59	52	58	29
1980-81[3]	34	45	36	31	29
Mean snow depth per measurement					
1978-79[2]	1.93	2.76	2.21	ND	.55
1979-80[3]	.83	1.26	.82	.72	.31
1980-81[3]	.38	.56	.22	.16	.17

[1] Nov. 9 - Apr. 13

[2] Dec. 28 - Apr. 13

[3] Entire snow period

Significantly lower average wind speeds during winter and spring 1980-81 as compared with the previous two years (Table 4) contributed to the overall moderate conditions that prevailed on east side (Brackett Creek and Livingston) winter ranges. Wind speeds have not varied significantly between years on the west side winter ranges during the three years of measurement. The relatively low wind speeds in unprotected areas (east side) in 1980-81 can be related to the occurrence of long periods of deeply entrenched high pressure that was responsible also for the high temperatures and low precipitation.

Table 4. Mean winter/spring wind speeds (miles/hour) on five mule deer winter ranges in the Bridger Mountains, 1978-1981.

	Schafer Creek	Armstrong	Blacktail Mountain	Brackett Creek		Livingston
				Leffingwell	Peckenpaugh	
1978-79	1.63	2.54	2.66	4.60	6.39	6.68
1979-80	1.04	2.40	2.58	4.23	5.66	6.36
1980-81	Disc.[1]	2.42	2.65	3.95	4.77	5.79

[1]Weather station abandoned

The mild conditions and lack of an early spring snowpack contributed to earlier plant growth and development in 1981 than either of the two previous years. Some plants began to green up and flower by mid-March. Cool temperatures in April and May slowed phenological development somewhat, but development remained ahead of the prior two years.

Vegetational Characteristics

Vegetation "cover" types and their relative occurrence on the Brackett Creek and Armstrong winter ranges were described by Mackie et al. (1980). The amount and relative proportions of thirty-one major cover types within the total yearlong ranges of the Brackett Creek and Northwest Slope (which includes the Armstrong area) populations are shown in Table 5. One notable difference between the two areas was that all types characteristic of the high, cold, rocky sites occurred on the northwest slope range, while most of those found on low, warm, dry sites occurred on Brackett Creek. Mesic forested types were fairly abundant on both ranges. The four plant species most abundant on both ranges were Douglas fir, Idaho fescue, bluebunch wheatgrass, and elk sedge.

To develop cover type descriptions, relative timber density was estimated from aerial photographs using four subjective density classes: (1) scattered, (2) open, (3) medium, and (4) dense. The percent occurrence of each of those classes on each of the two ranges is shown in Figure 2. The area covered by non-timbered land on the Brackett Creek range is more than twice that on the Northwest Slope, whereas the relative amounts of area in all forested classes are lower on Brackett Creek. Most of the non-timbered area on the Brackett Creek range is available as winter range, whereas only a fraction of the small amount of non-timbered types within the Northwest Slope range is used during winter since much is above timberline.

Table 5. Percentage and total area (ha) covered by major vegetation types on each of two mule deer ranges in the Bridger mountains.

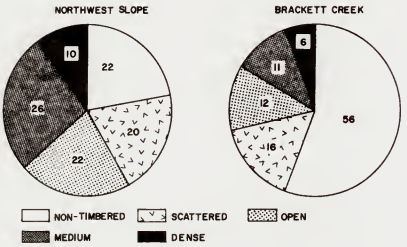
Vegetation Type[1]	Northwest Slope Range		Brackett Creek Range	
	Percent[2]	ha[3]	Percent	ha
Agropyron spicatum/Chrysopsis villosa/Crysopsis hymenoides	0	0	2.69	489
Rhus trilobata/Agropyron spicatum/Pinus flexilis/Juniperus scopulorum	0.2	2	2.42	440
Poa nevadensis/Artemisia frigida/Koeleria macrantha	0	0	3.77	686
Agropyron spicatum/Festuca idahoensis	1.21	123	8.09	1471
Artemisia tridentata/Agropyron spicatum	0	0	5.24	953
Festuca idahoensis/Agropyron spicatum	4.25	432	3.68	669
Agropyron spicatum/Juniperus scopulorum/Pseudotsuga menziesii	1.80	183	2.31	420
Festuca idahoensis/Antennaria rosea	0	0	5.32	968
Artemisia tridentata/Festuca idahoensis/Poa pratensis	.94	96	2.49	453
Artemisia tridentata/Poa pratensis/Phleum pratense	.99	101	4.25	773
Poa pratensis/Phleum pratense/Geranium viscosissimum	3.74	381	2.03	369
Festuca idahoensis/Agropyron caninum/Geranium viscosissimum	2.70	275	1.64	298
Pseudotsuga menziesii/Festuca idahoensis	1.01	103	1.92	349
Pseudotsuga menziesii/Symphoricarpos albus	3.55	361	2.64	480
Pseudotsuga menziesii/Symphoricarpos albus/Calamogrostis rubescens	1.07	109	2.59	471
Pseudotsuga menziesii/Carex geyeri	6.06	617	6.51	1184
Bromus carinatus/Pseudotsuga menziesii/Carex geyeri	6.47	658	2.50	455
Pseudotsuga menziesii/Calamogrostis rubescens	6.85	697	2.96	538
Pseudotsuga menziesii/Vaccinium globulare	2.00	204	1.26	229
Pseudotsuga menziesii/Pinus contorta/Vaccinium globulare	.57	58	2.63	478
Pinus contorta/Vaccinium globulare	2.39	243	0	0
Mertensia ciliata/Bromus carinatus	2.29	233	.01	2
Abies lasiocarpa/Vaccinium globulare	2.96	301	.12	22
Lonicera utahensis/Epilobium paniculatum/Bromus carinatus	2.55	259	0	0
Picea/Abies lasiocarpa/Vaccinium globulare	3.53	359	0	0
Abies lasiocarpa/Arnica cordifolia	2.23	227	0	0
Abies lasiocarpa/Clematis pseudoalpina	2.55	259	0	0
Pinus albicaulis/Vaccinium scoparium	2.13	217	0	0
Alpine Scree	5.29	538	0	0
Hayfields	.74	75	4.74	862
Grainfields	0	0	3.92	713
Percent of area covered by all these types:	69.89	7112	75.73	13909
Total Number of vegetation types delineated for the area:	80		81	

[1]Named according to dominant overstory and understory species. Arranged approximately in order of warmest to coldest.

[2]Percent of each area covered by each type.

[3]Number of hectares covered by each type.

Figure 2. Percent occurrence of timber density categories on the Armstrong (Northwest Slope) and Brackett Creek mule deer ranges in the Bridger Mountains.



DISTRIBUTION, MOVEMENTS AND HABITAT USE

Winter

Because weather conditions were very mild and snow cover was essentially absent, deer were widely distributed throughout their year-long ranges until mid-January. In late winter, deer were distributed similar to previous years.

Summer

Seasonal distribution and movements during 1980-81 were similar to other years. Data on all movements of radio-collared deer is currently being compiled and analyzed for a separate report.

POPULATION CHARACTERISTICS

Trend and Dynamics of the Armstrong Deer Population

Trend in mule deer numbers and sex-age composition of the spring population on the Armstrong winter range from 1973-1980 were discussed in previous reports (Mackie et al. 1978, 1979, 1980). Population estimates for mule deer using the Armstrong winter range during spring 1981 are presented in Tables 6 and 7.

Table 6. Late winter estimates of numbers of mule deer on the Armstrong winter range, April, 1981.

Estimated Numbers		Remarks
Total	S	
170	19.93	$\bar{X}$ Lincoln Index for 8 ground surveys (55-119 deer obs./survey) and 71 collars in population.
168		Schnabel Index for 8 ground surveys (55-119 deer obs./survey) and 71 collars in population.

Table 7. Estimated late winter-spring mule deer populations on the Armstrong winter range, 1973-81.

Year	Total No.	No. Adult Females	No. Males		No. Fawns
			Adult	Yearling	
1973	230	123	31	27	49
1974	220	130	27	23	40
1975	140	92	35	8	5
1976	170	118	37	3	12
1977	200	120	24	6	50
1978	160	116	6	6	32
1979	140	104	6	11	19
1980	160	95	14	7	44
1981	170	98	13	6	53

Cumulative ground, aerial observations and trapping records provided data on numbers of marked deer on the area throughout the winter. At the end of April, approximately 92 deer wearing recognizable collars used the areas between Tom Reese Creek and North Cottonwood Creek. Of those, 71 ranged between Bill Smith and North Cottonwood Creeks. One additional deer was marked after the April ground surveys. Even more marked animals could have been present since the fate of 2 fawns marked in 1981 was undetermined and 11 of 74 adults of unknown status were last seen in spring 1980. The mean percentage of collared deer in April observations between Bill Smith and North Cottonwood Creeks was 42%.

The best estimate of mule deer numbers on the Armstrong winter range was 170 during spring 1981. The mean Lincoln index for 8 ground surveys in April was 170 mule deer. The Schnabel index was similar at 168 deer. The current estimate represents an increase of approximately 10 animals (6%) over the population estimate for spring 1980.

Estimates of mule deer numbers on the Armstrong range during early winter (Figure 3) were reconstructed from the spring population using overwinter mortality rates of marked adults, and fawn:female and male:female ratios observed during classification flights in January. The early winter population estimate of 188 deer included about 99 adult females, 14 adult males, 7 yearling males, and 68 fawns.

The estimated 170 deer on the Armstrong range in spring 1981 included approximately 98 adult females, 13 adult males, 6 yearling males, and 53 fawns (Table 7). When compared with estimates for early winter, overwinter mortality was very light--approximately 10% of the early winter population. Known deaths included two fawns found dead during a systematic search for carcasses in late May. Overwinter fawn mortality was light, about 22% of early winter numbers. Confirmed adult mortality was limited to a 10+ year old female, one yearling male, and the trap-related death of a $4\frac{1}{2}$ year old male.

Hunting mortality of males appeared to be higher in 1980 than the previous year. Tag returns in 1979 indicated that 2 (9%) of 22 marked males were killed. During the 1980 hunting season, 5 (28%) of 18 marked males were shot. However, 4 (22%) of the 18 marked males which left the winter range in May 1980 and presumed to be alive during fall were not observed during the winter. Fifty percent of the marked males were known to be alive at the close of the hunting season. Hunting was for males only, except for 500 either sex permits issued for HD 312 which includes the Bridger Range. During the 1980 hunting season, a special questionnaire was sent to all 500 either sex permit holders for HD 312; 428 (86%) were returned. Harvest and hunting season projections were made from the returned sample for all 500 permit holders.

An estimated 320 (64%) of 500 permittees actually hunted deer in HD 312. Hunters averaged 3.7 days afield. Of those that hunted, 56% were successful as compared to only 41% in 1979. Permit holders harvested an estimated 180 deer in 1980, a 32% increase over the 1979 harvest of 136 deer. The 1980 harvest consisted of 164 mule deer (107 F, 41 M, 16 fawns) and 16 whitetailed deer.

Fawn Production and Survival

Aerial classifications of deer on the Armstrong range during helicopter surveys in early January and mid-March 1981 are listed and compared with previous years in Table 8. The observed ratios, 69 fawns:100 females and 57 fawns:100 adults in 1981 indicated comparatively high fawn survival to early winter. The mid-March ratio of 55 fawns:100 adults was the highest recorded since the study began in 1972. Some fawn mortality may have occurred after the helicopter survey in mid-March, since ground observations in April indicated a fawn:adult ratio of 45:100. Late spring population estimates show 40 fawns:100 females in spring 1973, 31:100 in 1974, 5:100 in 1975, 10:100 in 1976, 42:100 in 1977, 27:100 in 1978, 18:100 in 1979, 46:100 in 1980, and 54:100 in 1981. Therefore, fawn survival to spring was higher than all other years.

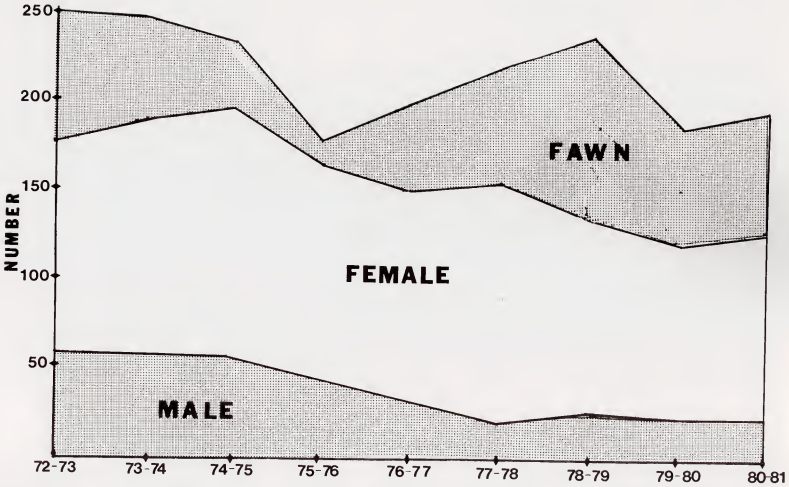


Figure 3. Early winter population trend of mule deer on the Armstrong winter range, Bridger Mountains, 1972-81.

Table 8. Aerial classifications of mule deer on the Armstrong winter range, January 1972 through March 1981.[1]

Reese Creek - N. Cottonwood	NUMBERS							RATIOS			PERCENTAGES		
	Total Count	Total Class.	Adults	Males	Females	Fawn	Uncl.	F:100 Females	F:100A	Males:100 Females	% Fawn	% Ylg. Males	% Spike Ylg. Male
1971-72 Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
1972-73 Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
1973-74 Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
1974-75 Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
1975-76 Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-
1976-77 Jan. 5-9	90	90	70	14	56	20	-	36	29	25	22	21	100
Mar. 10-11	116	116	87	-	-	29	-	-	33	-	25	-	-
1977-78 Dec. 19	133	133	94	11	83	39	-	47	42	13	29	46	40
Apr. 2	126	126	101	-	-	25	-	-	25	-	20	-	-
1978-79 Dec. 26	118	118	68	14	54	50	-	93	74	26	42	43	29
Mar. 12	98	98	68	-	-	30	-	-	44	-	31	-	-
1979-80 Jan. 9	132	132	85	16	69	47	-	68	55	23	36	37	50
Mar. 17	101	73	28	-	-	28	-	-	38	-	28	-	-
1980-81 Jan. 8	69	68	44	7	36	25	1	69	57	19	36	29	50
Mar. 19	129	129	83	-	-	46	-	-	55	-	36	-	-

[1] Includes some animals ranging between Bill Smith and Reese Creeks not included in the Armstrong winter range population.

Table 9 . Numbers and sex and age ratios of mule deer classified by aerial (helicopter) survey on various winter ranges in the Bridger Mountain complex during early and late winter, 1971-72 through 1980-81.

		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78		1978-79		1979-80		1980-81	
		Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
	No. Classif.	204	352	323		367	358*	412	600	288	266	216	281	325	315	302	252	285	325	69	345
NO. END	♂♂/100 ♀♀	39.6	-	-		39.8	-	31.1	-	29.9	-	24.7	-	19.7	-	16.7	-	18.8	-	19.4	-
WEST SLOPE	FF:100 ♀♀	62.3	-	-		38.3	-	34.8	-	9.2	-	37.0	-	48.7	-	84.7	-	66.2	-	69.4	-
	FF:100 AD	44.6	29.9	32.7		27.4	19.0	26.5	9.4	7.1	6.1	29.6	34.4	40.7	30.3	72.5	39.9	55.7	46.4	56.8	63.1
	No. Classif.	470	332	271		176	162	459	448	335	307	335	365	336	121	277	473	325	504	-	571
SO. END	♂♂/100 ♀♀	39.1	-	-		39.6	-	22.8	-	28.6	-	27.2	-	25.0	-	11.2	-	20.4	-	-	-
WEST SLOPE	FF:100 ♀♀	45.4	-	-		32.6	-	51.1	-	25.8	-	46.1	-	53.7	-	61.2	-	61.4	-	-	-
	FF:100 AD	32.6	26.7	38.1		23.4	14.8	41.6	31.7	20.0	12.0	36.2	30.8	42.9	31.2	55.0	39.9	50.9	43.5	-	54.7
	No. Classif.	-	-	-		-	-	79	-	174	-	69	133	221	93	172	92	-	191	-	194
BLACKTAIL	♂♂/100 ♀♀	-	-	-		-	-	48.6	-	33.3	-	24.3	-	19.2	-	11.9	-	-	-	-	-
MOUNTAIN	FF:100 ♀♀	-	-	-		-	-	64.8	-	27.7	-	62.1	-	50.7	-	90.4	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	43.6	-	20.8	-	50.0	37.1	42.5	40.9	80.8	27.8	-	59.1	-	59.0
	No. Classif.	-	-	-		-	-	378	-	290	-	307	-	543	-	601	728	-	725	-	881
SOUTH	♂♂/100 ♀♀	-	-	-		-	-	6.2	-	16.2	-	5.0	-	7.5	-	14.0	-	-	-	-	-
16-MILE	FF:100 ♀♀	-	-	-		-	-	24.5	-	22.4	-	49.2	-	68.2	-	67.7	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	23.1	-	19.3	-	46.8	-	63.4	-	59.4	46.8	-	71.3	-	80.9
	No. Classif.	-	-	-		-	-	665	483+	766	725	814	831	910	1050	1267	1041	700	1204	-	-
NORTH	♂♂/100 ♀♀	-	-	-		-	-	6.6	-	15.9	-	8.0	-	9.5	-	14.9	-	16.8	-	-	-
16-MILE	FF:100 ♀♀	-	-	-		-	-	35.3	-	23.4	-	43.3	-	67.8	-	77.5	-	88.8	-	-	-
	FF:100 AD	-	-	-		-	-	33.2	32.7	22.1	10.0	40.0	25.9	61.9	39.3	67.6	47.6	76.0	65.8	-	-
	No. Classif.	-	-	-		-	-	-	-	148	-	81	-	388	-	629	515	-	608	-	396
BATTLE	♂♂/100 ♀♀	-	-	-		-	-	-	-	5.3	-	24.3	-	22.8	-	24.6	-	-	-	-	-
RIDGE	FF:100 ♀♀	-	-	-		-	-	-	-	25.6	-	54.1	-	78.2	-	96.1	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	-	-	24.3	-	47.2	-	63.7	-	77.1	42.7	-	65.7	-	94.1
	No. Classif.	-	-	-		-	-	299	-	560	-	-	-	978	509	1120	1057	579	1017	446	1212
BRACKETT	♂♂/100 ♀♀	-	-	-		-	-	11.3	-	5.0	-	-	-	12.2	-	13.1	-	7.5	-	11.3	-
CREEK	FF:100 ♀♀	-	-	-		-	-	49.4	-	32.5	-	-	-	74.1	-	77.2	-	81.7	-	91.3	-
	FF:100 AD	-	-	-		-	-	44.4	-	31.0	-	-	-	66.0	51.2	68.1	31.1	76.0	64.6	82.0	97.4
	No. Classif.	-	-	-		-	-	300	-	223	-	-	-	266	-	460	436	-	485	-	587
LIVINGSTON-	♂♂/100 ♀♀	-	-	-		-	-	12.8	-	10.7	-	-	-	18.9	-	24.1	-	-	-	-	-
BILLMAN CR.	FF:100 ♀♀	-	-	-		-	-	41.0	-	26.1	-	-	-	67.1	-	74.4	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	36.3	-	23.6	-	-	-	56.4	-	57.6	28.2	-	63.9	-	95.7
	No. Classif.	-	-	-		-	-	-	-	-	-	-	-	28	-	26	-	-	22	-	-
OTHER	♂♂/100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	7.1	-	11.1	-	-	-	-	-
MISCELLANEOUS	FF:100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	92.9	-	100.0	-	-	-	-	-
AREAS	FF:100 AD	-	-	-		-	-	-	-	-	-	-	-	86.6	-	90.0	-	-	100.0	-	-
	No. Classif.	674	648	794		541	518	2592	1531	2784	1298	1842	1610	4060	2088	4854	4594	1889	5081	515	4203
BRIDGER	♂♂/100 ♀♀	39.3	-	-		39.7	-	14.8	-	16.5	-	13.5	-	14.6	-	16.0	-	19.1	-	12.5	-
RANGE	FF:100 ♀♀	50.3	-	-		36.4	-	38.7	-	25.1	-	45.0	-	66.4	-	77.7	-	78.1	-	88.3	-
TOTALS	FF:100 AD	36.1	28.3	34.4		26.1	18.5	33.7	22.3	21.5	9.7	39.6	29.3	58.0	39.9	66.9	43.9	67.9	62.1	78.2	81.3

*964 including 100+ unclassified
+Northwest of 16-Mile Creek only

General Population Characteristics of Bridger Mountain Mule Deer 1980-81

Totals of 515 and 4,203 mule deer were classified during the early and late winter helicopter surveys (Table 9). Only the Brackett Creek and Armstrong winter ranges were surveyed in early winter. The entire Bridger Range excluding the North 16-mile winter range was flown in late winter. Widespread early winter deer distribution prevented full coverage helicopter surveys and precluded the computation of reliable sampling efficiencies.

The total count for the entire Bridger Range in late winter 1980-81 was higher than the two previous winters. Late winter sampling efficiencies, estimated from marked animals, were 43% for the west slope, 53% for Brackett Creek and South 16-mile, and 48% for Battle Ridge and Livingston. Using those data, a total population of 8,620 mule deer for the entire Bridger Range was estimated for late winter 1980-81. This was approximately 11% higher than the 1979-80 late winter estimate of 7,750 and suggests a continuing trend of increasing mule deer populations throughout the Bridger Range.

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Submitted by: David F. Pac

Henry E. Jorgensen

Richard J. Mackie

STUDY NO. BG-1.0 JOB NO. 1 (Supplement)

JOB TITLE: Ecology of the mule deer associated with the Brackett Creek winter range in the Bridger Mountains, Montana

JOB OBJECTIVES:

1. To describe vegetational characteristics and forage production by major browse species on the Brackett Creek winter range;
2. To further determine and define the distribution, movements, habitat use, and population characteristics of mule deer associated with the Brackett Creek winter range; and
3. To compare habitat and population characteristics of mule deer on Brackett Creek with similar data for mule deer habitats and populations on the west slope of the Bridger Mountains.

FINDINGS:

This study was conducted as a graduate (MS) thesis research project within the framework of studies of the population ecology and habitat relationships of mule deer in mountain-foothill habitats in southwestern Montana. Field work was completed during the fall of 1980 and the final thesis report was submitted in June 1981 as a supplement to the 1980-81 progress report for Study No. BG-1, Job No. 1. An abstract of that thesis by Alfred I. Rosgaard is presented below.

ABSTRACT:

This study was conducted from June 1979 to December 1980 in the Bridger Mountains of southwestern Montana. The objectives were to describe vegetational characteristics of the Brackett Creek winter range and to monitor the movements, distribution, habitat use, and population characteristics of mule deer associated with that winter range. Grasslands, big sagebrush, agricultural, and skunkbush-limber pine-juniper vegetation cover types comprised 42%, 24.5%, 17.5%, and 5.8% of the Brackett Creek winter range, respectively. Total current annual growth twig production of big sagebrush, antelope bitterbrush, and skunkbush sumac was determined to be 1,124,907 kg on 3 grass and 8 shrub dominated cover types. Those 3 species made up 96%, 1.9%, and 1.7%, respectively. Mule deer were widely distributed on the winter range throughout the winter of 1979-80. Mean winter home range size for 11 radio-collared deer was 3.06 km^2. Big sagebrush, skunkbush-limber pine-juniper, grassland, and agricultural vegetation types accounted for 51%, 16%, 15%, and 11% of the winter habitat use by marked deer. During summer, deer were distributed throughout the herd range in 3 segments. One segment was resident on the winter range. The other 2 segments were migratory and included 1 group that used open habitats on the periphery of the winter range and another that moved to forested habitats at higher elevations. Summer home range sizes of radio-collared does averaged 3.7 and 3.1 km^2 for 1979 and 1980, respectively. Mule deer using the open shrub and grassland types had larger home ranges (7.6 km^2) than those that inhabited forested habitats (2.1 km^2). Douglas fir, big sagebrush, and swale cover types

received, respectively, 47%, 21%, and 14% of the total summer-fall habitat use. Total population estimates of 2,105 and 2,010 were calculated for early and late winter 1979-80, respectively. Adult females, fawns, and adult males comprised 61%, 43%, and 4%, respectively, of the early winter population. Fawn production was 1.56 and 1.64 per radio-collared doe for 1979 and 1980, respectively. Overwinter mortality was low for the 1979-80 winter. Fawn:adult ratios decreased from 76 to 65 fawns/100 adults from early to late winter, representing an estimated loss of only 140 fawns. A minimum of 33 deer in 1979 and 66 in 1980 were killed during the fall hunting seasons. The Brackett Creek mule deer population may be stabilized at about 2,000-2,300 deer without apparent winter range browse deterioration or excessive hunting mortality, and despite high fawn production and survival.

STUDY NO. BG-1.0 JOB NO. 2

JOB TITLE: Population ecology and habitat relationships of mule deer in river breaks habitat in northcentral Montana.

ABSTRACT:

Severity indices indicated that the 1980-81 winter was the mildest of any winter during the 1960-1981 period. The 1980-81 period was also extremely dry, approaching the severe drought of 1960-61, but the droughty conditions did not appear to have any significant effect on the deer population. Fawn production and recruitment were excellent in 1980-81, but population growth slowed considerably. Observations of marked animals indicated that increased dispersal by yearling females as population density increases may account for the slower population growth. Mortality of deer continued to be low; coyote predation remained the major source of documented mortality. Hunter success and total harvest were higher than previous years. Appended results of siren surveys indicated that average numbers of coyote responses per station and the average densities of responding coyotes were similar to slightly higher in 1980 than in 1979. Results of vegetation production studies showed that in 1980 sweetclover production was extremely low and that dry matter production of other forbs and shrubs was generally lower than in other years of measurement, except 1977. Forbs, grasses, and different species of shrubs apparently respond differently to annual weather conditions.

JOB TITLE: Population ecology and habitat relationships of mule deer in river breaks habitat in northcentral Montana.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with timbered breaks habitat of central and eastern Montana;

2. To relate those basic population parameters to (a) characteristics of specific individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, coyote predation, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically, for timbered breaks habitats.

INTRODUCTION

In 1960, an intensive study of mule deer and their relationship to elk *(Cervus canadensis)* and domestic livestock was established on a representative 75,000 acre area in the Missouri River Breaks approximately 25 miles northeast of Roy, Montana. Habitat use and population studies were conducted from June 1960 through September 1963 and intermittently from October 1963 through May 1964 (Mackie 1970). From the summer of 1964 through spring 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer (Mackie 1976). Mackie (1970) presented historical information on mule deer in the "Breaks", discussed development of the existing population from the late 1930's through the early 1950's, and described trends in numbers, sex and age composition and harvest from 1960 through winter-spring 1964. Subsequent reports (Mackie 1966, 1973 and 1976) extended these data through early winter 1975-76.

In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks type habitat of eastern Montana. Results through June 1980 were reported previously (Hamlin 1977, 1978, 1979, 1980). In 1976, special studies were established to evaluate coyote-deer relationships. These included graduate thesis research projects investigating mortality of mule deer fawns during summer (Dood 1978, Riley 1981) and the distribution and abundance of small mammals (Trout 1978). They also included determination of coyote population characteristics and trends (Pyrah 1980, Schladweiler 1980). During the summer of 1976, a special study was also established to measure annual production of various grasses, forbs and browse species on various habitat types and to relate forage production to seasonal and annual weather conditions.

This report summarizes data collected during 1980-81 concerning deer population trends and characteristics and their relationship to environmental factors. Data on coyote population trends are summarized and discussed in Appendix A, while data on forage production and trends are presented and discussed in Appendix B.

STUDY AREA

The south study area encompasses all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles on a 4 to 7 mile wide belt adjacent to the Missouri River in Fergus County, Montana (Fig. 1). It comprises approximately 100 square miles between U.S. Highway 191 on the west, the Skyling Trail on the east, the Missouri River on the north and the Musselshell Trail on the south. Physiography, climate, land use and vegetation of this area were described in detail by Mackie (1970). Some of the work described in this report was conducted on the adjacent Missouri River Bottomlands described by Allen (1968) and NE across the river on the Nichols Coulee Resource Conservation Area (north study area) described by Knowles (1975).

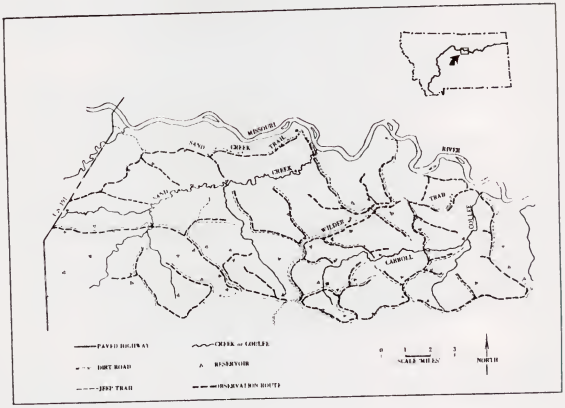

Figure 1. Map of the study area.

METHODS

Population data were obtained during fixed-wing surveys at various times of the year and helicopter surveys during December and March (Mackie, Hamlin and Pac 1980). Sex and age classifications and deer distribution and habitat use were obtained during all aerial surveys. Population estimates were made using data from helicopter surveys in most years. During the last 3 years, sufficient numbers of marked deer were present on the study area to permit use of the Lincoln Index (Overton and Davis 1969) for all aerial surveys. Supplementary information was obtained throughout the year from the ground during the course of normal activities.

Data on initial fawn production and subsequent fawn survival were obtained by aerial and ground reconnaissance. Survival was also measured by following radio-collared fawns. The river and reservoir ice was flown periodically during winter to check for coyote-killed deer. The uplands were checked for coyote-killed deer during aerial flights to relocate collared deer and during other normal activities. Carcasses are listed as probable coyote kills based on evidence of tracks in the snow, trails of blood on snow or vegetation and other site evidence.

Deer have been captured during winter in order to attach radio transmitters or observational collars. Methods have included the cannon net (Mackie et al. 1975), the Clover trap (Clover 1954), a helicopter drive net and darting from a helicopter. Newborn fawns were caught by the method described by Dood (1978).

Aerial relocations of radio-collared deer were obtained at 1-2 week intervals and relocations from the ground were made as time permitted.

Other techniques have been described in previous reports (Hamlin 1977, 1978, 1979, 1980).

RESULTS

Weather

Three winter severity indices are presented in Figure 2. Index 1 is calculated as follows:

$$\text{Index value} = (\text{Warmest ave. winter temp.} - \text{ave. winter temp.}) + \frac{(\text{Total winter snowfall} - \text{least winter snowfall})}{5}$$

Index 2 was presented in Hamlin (1979) and Index 3 is that of Picton and Knight (1969). Data necessary to calculate indices 2 and 3 were not available for years prior to 1968. Index 1 shows the same relative severity of winters and enables comparison of winters back to 1960-61 when the study was initiated. The 1980-81 winter was the mildest of any during the

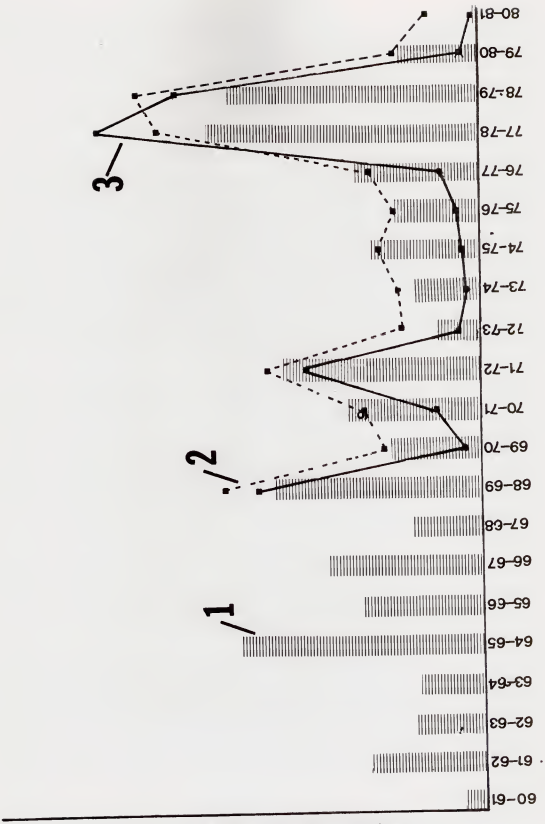

Figure 2. Trend in winter severity in the Missouri River Breaks, Montana, from 1960-61 through 1980-81, as indicated by 3 severity indices (see text).

1960-1980 period. The reporting period was also almost as dry as that during the 1960-61 drought. It is noteworthy in terms of deer-weather relationships that neither the severe winters of 1977-78 and 1978-79 nor the dry growing season of 1980 appeared to have significant adverse effects on the deer population (Fig. 2, Fig. 3).

Population Trend

South Study Area

Fawn production and recruitment were excellent during 1980-81, but population growth slowed considerably (Fig. 3, Tables 1, 2). Data presented in Table 3 may help explain the slower rate of population growth during the last year. These data indicate that from 1977 to 1979, the female population grew each year at about the same rate that female fawns were recruited. The male segment grew more slowly, partially because of hunting mortality. During 1980, the female segment increased by only about one-half the number of females estimated to have been recruited. The data from marked animals indicated very little mortality of adults during this period. The population estimates (Table 3), however, indicated that about 100 females were lost from the population.

Data from marked fawns indicated that from 1977-79 only one of 10 yearling females dispersed from the study area. The one dispersal occurred in 1979. In 1980, 3 of 11 yearling females dispersed from the study area. These limited data suggest that dispersal from the study area by yearling females may have increased as the population became more dense. During the 4 year period, 11 of 19 yearling males dispersed from the study area, 4 dispersed from the home range they occupied during their first year, but remained on the study area, and 4 stayed within their first year's home range. The rate at which yearling males dispersed appeared unrelated to population density.

Deer dispersing from other areas could potentially replace those that left; it is unlikely that this occurred. Dispersal should occur from areas of high density to areas of lower density. Since the study area contains a higher density of deer than the area immediately surrounding it, net movement should be out of the study area.

Dispersal occurs during the period just prior to the birth of new fawns and for about a month afterward. The doe is intolerant of other deer at this time and aggressively chases any deer near her, including her fawns from the previous year. As population density increases, there are fewer and fewer places nonparous yearlings can occupy without being exposed to continuous aggression from females with new fawns. It is hypothesized that yearlings will travel until they find an area where they are not subjected to constant aggression by other deer. As population density increases, this frequently means leaving the population unit.

To date, maximum known dispersal distances have been 45 airline miles for a yearling female and 55 airline miles for a yearling male. The sample size of marked fawn-yearlings have been small, but additional marking

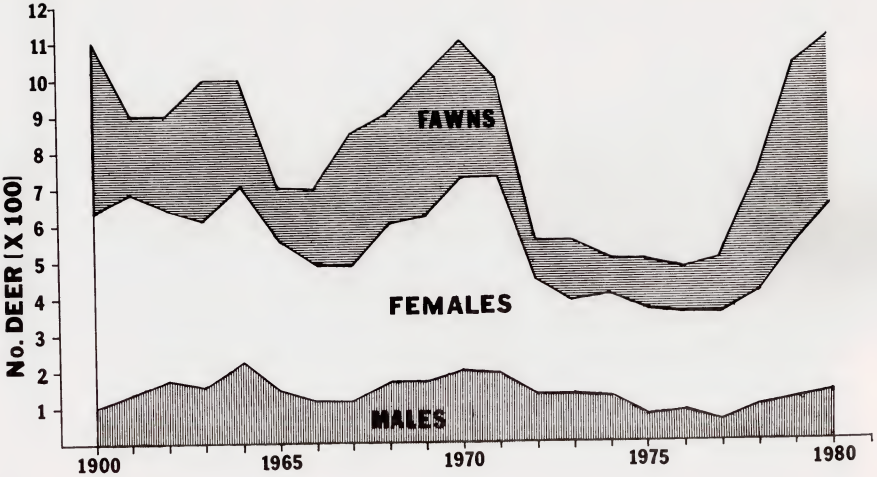

Figure 3. Population trend of mule deer on the Missouri River Breaks Study Area, 1960-1980.

Table 1. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1980-81. Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg. Males	
			Males	Females	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
1976-77	Aerial	258	17.4	57.4	25.2	30.4	43.9	33.6	40	
1977-78	Aerial	322	10.9	58.7	30.4	18.5	51.9	43.8	48	
1978-79	Aerial	501	13.2	42.3	44.5	31.1	105.2	80.2	55	
1979-80	Aerial	675	11.3	41.0	47.7	27.4	116.2	91.2	54	
1980-81	Aerial	850	12.5	45.8	41.8	27.2	91.3	71.7	64	

[1]Cumulative observations on area during December.
[2]All aerial observations by helicopter except 1969-70 (fixed-wing aircraft).
[3]Only west half of area surveyed in 1967-68.

Table 2. Classifications and observed recruitment of fawns on the south side Missouri Breaks study area, 1975-76 through 19 80-81.

Date	Numbers	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Adults	Fawns/ 100 FF
Sept.-Oct. 1975	105	69	36	50	19	-	52	72
December 1975	323	236	87	186	50	-	37	47
March 1976	193	173	19	--	--	-	11	--
October 1976	159	110	49	79	31	-	45	62
December 1976	258	193	65	148	45	-	34	44
March 1977	293	225	68	--	--	-	30	--
October 1977	112	70	41	51	20	-	59	80
December 1977	322	224	98	189	35	-	44	52
March 1978	255	195	51	--	--	9	26	--
September 1978	176	102	74	69	33	-	73	107
December 1978	501	278	223	212	66	-	80	105
March 1979	409	248	161	--	--	-	65	--
October 1979	278	157	120	100	57	1	76	120
January 1980	680	353	322	277	76	5	91	116
March 1980	683	375	308	--	--	-	82	--
September 1980	548	355	190	216	139	3	54	88
January 1981	854	495	355	389	106	4	72	91
March 1981	747	458	280	--	--	9	61	--

Table 3. Population estimates of mule deer on the south Missouri River Breaks study area.[1]

	Males	Females	Fawns	TOTAL
1977-78 Early Winter	55	295	150	500
Late Winter	50	280	85	415
	43	42		
Predicted E. Winter 1978-79	93	322		
1978-79 Early Winter	95	310	325	735
Late Winter	90	295	250	635
	125	125		
Predicted E. Winter 1979-80	215	420		
1979-80 Early Winter	115	410	475	1000
Late Winter	105	395	410	910
	205	205		
Predicted E. Winter 1980-81	310	600		
1980-81 Early Winter	135	505	460	1100
Late Winter	130	480	370	980
	185	185		
Predicted E. Winter 1981-82	315	665		

[1]Early and late winter estimates are based on Lincoln Indexes, changes in sex and age ratios, and other indicators (Mackie et al 1980). Predicted levels do not take hunting loss, dispersal or other mortality occuring between June and December into account.

should help to refine and test the hypothesis. This hypothesis can explain how population growth can slow while fawn recruitment remains high and adult mortality is low. Dispersal accounts for some of the missing males in the population estimates, but hunting mortality (Table 4) also accounts for a major portion.

North Study Area

No classifications or population estimates were made on the north study area during the past year.

White-tailed Deer

White-tailed deer classifications on the river bottom adjacent to the south study area are presented in Table 5. The two surveys made during winter 1980-81 did not allow calculation of reliable population estimates. General indications were that the population was somewhat larger than the previous year. The data in Tables 1, 2 and 5 indicate that production and/or survival of fawns in the white-tailed deer population has continued to follow the same general trend as that in the adjacent mule deer population.

Production and Mortality

Initial fawn production by individual females was again high during 1980 (Table 6) indicating no problem with conception or in utero loss. Fawn recruitment, while lower than in 1979-80, was much better than in early years of the study (Table 7). Thirteen percent of the radio-collared fawns died during summer 1980 (Table 8). These deaths were attributed to coyote predation. One radio-collared fawn (8%) died during fall. Death was attributed to a massive infection originating from a puncture wound between a front hoof. One non-collared fawn was found dead during fall. Death appeared to be due to internal injuries resulting from an accident. One radioed fawn (9%) died during winter. Death was attributed to coyote predation.

Probable coyote-killed deer found during winter field work are listed in Table 9. Numbers of observed coyote-killed deer remained at a low level compared to the period 1975-77. Coyote predation on deer remained relatively low in spite of the large decline in mice populations. Coyote predation, however, remained the major documented cause of mortality of antlerless deer.

Hunting mortality was again limited to adult males. Hunter success improved (Table 4). Post-season male:100 female ratios were not significantly different than in previous years (Table 1). Thus, the higher hunter success appeared to be related to greater absolute numbers of males available to hunters rather than the harvesting of greater proportion of the available males.

Table 4. Mule deer harvest statistics for HD 410 and the south side research area.[1]

Year	Mule Deer Bag Limit	HD 410[2] Harvest	Hunters	Min. known kill on research area	Open. day check sta. HD 410[2] Number Hunters	Kill
1959	2-ES	5,117	5,084			
1960	2-ES	5,769	6,486	150(73)[3]	407	129
1961	2-ES	5,951	7,091	151(65)	224	70
1962	2-ES	5,964	6,482	81(31)	350	70
1963	2-ES	6,683	5,925	37(16)	89	37
1964	2-ES	6,800	6,860	73(43)	117	55
1965	2-ES	2,945	3,680	28(14)	141	26
1966	2-ES	4,086	4,468			
1967	2-ES	2,603	3,587			
1968	2-ES	3,061	4,031			
1969	2-ES	3,102	3,399			
1970	2-ES	3,271	3,774			
1971	2-ES	4,245	7,351			
1972	2-ES	3,050	7,385			
1973	1-ES	1,689	5,847			
1974	1-ES	1,531	5,614			
1975	1-MM only	890	5,560			
1976	1-MM only	738	2,742	7(7)	48	4
1977	1-MM only	726	2,444	21(21)	73	5
1978	1-MM only	688	2,961	10(10)	36	2
1979	1-MM only	1,064	3,159	24(24)	48	11
1980	1-MM only	1,749	3,750	69(69)	85	22

[1]Point estimates for harvest from statewide hunter questionnaire.

[2]Data are for pre-1973 hunting district. HD 410 = present 410 + HD 417.

[3]Number of Adult males.

Table 5. White-tailed deer numbers and sex and age composition from early winter surveys, 1960-1981.

	Numbers					Ratios			
Year	Total	Adult	Young	Female	Male	YG:100 AD	YG:100 Females	Male:100 Females	% Yearling Males
1960-61[1]	28	18	10	-	-	55.5	-	-	-
1961-62[1]	120	54	66	-	-	122.2	-	-	-
1962-63[1]	106	76	30	-	-	39.5	-	-	-
1964-65[2]	188	168	20	123	45	11.9	16.3	36.6	36.8
1965-66[2]	178	137	41	110	27	29.9	37.3	24.5	15.0
1966-67[2]	223	162	61	121	41	37.6	50.4	33.9	25.6
1971-72[2]	267	182	60	139	43	33.0	43.2	30.1	-
1973-74[2]	207	168	39	146	22	23.2	26.7	15.1	40.9
1975-76[2]	121	105	16	76	29	15.2	21.0	38.2	27.6
1976-77[2]	18	15	3	10	5	20.0	30.0	50.0	66.7
1977-78[2]	110	96	14	58	38	14.6	24.1	65.5	44.7
1978-79[2]	90	69	21	53	16	30.4	39.6	30.2	43.8
1979-80[3]	141	75	66	66	9	88.0	100.0	13.6	22.2
1980-81[4]	160	116	44	77	39	37.9	57.1	50.6	64.9

[1]Ground sample classifications.
[2]Helicopter surveys.
[3]Super Cub survey - 1-16-80, some males had probably lost their antlers, so both yg:100 female and male:100 female ratios would be somewhat higher than shown in the Table.
[4]Super Cub survey.

Table 6 . Estimated mule deer fawn/female ratios in June and mid-July 1976-1980 on the south study area.

	Fawns/100 Producing Females		Percent Females Producing		Estimated Population Fawn/Doe ratio
June 1976	150:100(14)[1]	x	94[2]	=	141:100
July 1976	131:100(16)	x	71[3]	=	94:100
June 1977	152:100(27)	x	82[3]	=	125:100
July 1977	140:100(20)	x	76[3]	=	106:100
June 1978	165:100(26)	x	90[3]	=	148:100
July 1978	142:100(31)	x	83[3]	=	118:100
June 1979	176:100(37)	x	70[2]	=	123:100
July 1979	168:100(37)	x	70[2]	=	118:100
June 1980	168:100(22)	x	75[2]	=	126:100
July 1980	157:100(63)	x	75[2]	=	118:100

[1]Female Sample size in parenthesis.
[2]Percent of female population older than yearling.
[3]Percent of females observed alone or with fawns.

Table 7. Fawn production and survival on the south Missouri Breaks study area, 1975-76 through 1980-81.

	Fawns Per 100 Initially Producing Females	Approximate Mortality Rate	Percent Total Fawn Mortality	Total Fawn Mortality
1975-76				
Mid-June	150			
Mid-July	-	-	-	
October	83	-	-	
December	54	35	22	
March	16	70	28	
				89%
1976-77				
Mid-June	150			
Mid-July	101	33	45	
October	67	34	31	
December	47	30	19	
March	42	11	5	
				72%
1977-78				
Mid-June	152			
Mid-July	129	15	20	
October	98	24	27	
December	63	36	31	
March	38	40	22	
				75%
1978-79				
Mid-June	165			
Mid-July	131	21	43	
October	119	9	15	
December	117	2	2	
March	85	27	40	
				48%
1979-80				
Mid-June	176			
Mid-July	168	4	23	
October	171	0	0	
December	166	2	15	
March	150	10	62	
				15%
1980-81				
Mid-June	168			
Mid-July	157	7	17	
October	117	25	63	
December	121	0	0	
March	104	14	20	
				38%

Table 8. Summer mortality and causes for marked mule deer fawns 1976-1980.

Year	No.[1] Marked Fawns	No. Died	% Mort.	No. Definite Or Probable Coyote Killed	No. Unknown	No. Accident	% Coyote Killed
1976[2]	11	4	36	4	-	-	100
1977[2]	19	6	32	4	1	1	67
1978[3]	15	2	13	1	1	-	50
1979[3]	21	3	14	2	1	-	67
1980[3]	16	2	13	2	-	-	100
Total	82	17	21	13	3	1	76

[1]No. marked fawns column includes unmarked twin of radioed fawn when this situation occurred.
[2]Data from Dood (1978) and personal communication.
[3]Data from S. Riley (pers. comm.).

Table 9. Probable coyote-killed deer found during winter (December-March).

	Uplands	Bottomlands	River Ice	Reservoir Ice	TOTAL
Mule Deer					
1975-76	9	2	1	33	45
1976-77	4	0	3	9	16
1977-78	5	0	2	1	8
1978-79	3	0	1	1	5
1979-80	0	0	2	5	7
1980-81	2	0	5	2	9
White-tailed Deer					
1975-76	1	10	9	0	20
1976-77	0	1	3	0	4
1977-78	0	1	0	0	1
1978-79	0	1	1	0	2
1979-80	0	0	1	0	1
1980-81	0	0	2	0	2

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APPENDIX A

Coyote Population Characteristics and Trends in the Missouri River Breaks, 1976 - 1980

by

Duane B. Pyrah

INTRODUCTION

Concern about relationships between the density of coyotes and deer mortality in the Missouri River Breaks prompted the establishment of studies on coyote population characteristics and trends and coyote-deer relationships during 1975-76. The main field effort was completed during 1979-80 with results reported by Dood (1978), Trout (1978), Hamlin (1979, 1980), Pyrah (1980), and Schladweiler (1980). However, coyote population surveys were continued in relation to deer population studies. This report presents survey data for 1980 in comparison with similar data showing trends since 1976. Data were collected in the Missouri River Breaks as described by Pyrah (1980) using siren response surveys during summer. Aerial surveys were used to relocate coyotes (3) with functional transmitter collars.

RESULTS

The siren response surveys indicated approximately similar to slightly greater numbers of coyotes on all areas and routes during 1980 as compared with 1979 (Tables 1 and 2). Substantially greater numbers were indicated for the prairie (Musselshell-Skyline) portion of the South Study Area. The density of coyote responses averaged 0.28 coyotes/km^2 (Table 1). Routes located north of the Missouri River (North Study Area) had higher average numbers of coyotes responding per station and unit area than routes on the south area. The density of coyotes responding to sirens was much lower in prairie as compared with timbered breaks habitat (Table 2). It also appeared that prairie coyotes which were drastically reduced during 1979 recovered substantially in 1980.

Aerial relocations of radio-collared coyotes indicated one minor shift in den area use, increasing the den area for that individual (#4-7) and slightly increasing the overall average den area for males as compared with previous analyses (Pyrah 1980).

Table 1. Summary of siren survey coyote responses for high counts at each station, Missouri River Breaks, 1976-80.

Study Area/Route	Year	Number of Coyotes (C)	Number of Stations (S)	Average Coyotes Per Station (C/S)	Density of Response Coyotes (/km^2)
South					
Wilder-Sand Cr.	1976	56	11	5.09	0.28
	1977	51	12	4.25	0.23
	1978	35	12	2.92	0.16
	1979	56	12	4.67	0.25
	1980	62	13	4.77	0.26
Musselshell-Skyline	1976	50	10	5.00	0.27
	1977	33	10	3.30	0.18
	1978	40	11	3.64	0.20
	1979	28	11	2.55	0.14 (0.28)[1/]
	1980	46	11	4.18	0.23
Subtotals	1976	106	21	5.05	0.27
	1977	84	22	3.82	0.21
	1978	75	23	3.26	0.18
	1979	88	23	3.83	0.20 (0.27)[1/]
	1980	108	24	4.50	0.25
North					
Rock Cr.-Bell Rg.	1976	17	10	1.70	0.10 (0.19)[1/]
	1977	36	10	3.60	0.20
	1978	29	10	2.90	0.16
	1979	60	10	6.00	0.33
	1980	58	10	5.80	0.32
Nichols-7 Mile	1976	40	12	3.33	0.18
	1977	21	10	2.10	0.12
	1978	53	12	4.42	0.24
	1979	48	11	4.36	0.24
	1980	57	10	5.70	0.31
Subtotals	1976	57	22	2.59	0.14 (0.19)[1/]
	1977	57	20	2.85	0.15
	1978	82	22	3.73	0.20
	1979	108	21	5.14	0.28
	1980	115	20	5.75	0.31
Missouri Breaks Totals	1976	163	43	3.79	0.21 (0.23)[1/]
	1977	141	42	3.36	0.18
	1978	157	45	3.49	0.19
	1979	196	44	4.45	0.24 (0.27)[1/]
	1980	223	44	5.07	0.28

[1/] Adjusted for undercount (1976) and to indicate density in breaks habitat (1979).

Table 2. Comparison of coyote density and population trend between breaks and prairie habitats by siren responses assigned to den areas, Missouri River Breaks, 1976-80.

	Breaks (263 km^2)		Prairie (172 km^2)	
Year	No.	Density ($/km^2$)[1/]	No.	Density ($/km^2$)[1/]
1976	57	0.22	35	0.20
1977	39	0.15	21	0.12
1978	51	0.19	23	0.13
1979	67	0.25	12	0.07
1980	68	0.26	32	0.19
Average	56	0.21	25	0.14

[1/] Density of responding coyotes, not corrected for estimates of nonresponders.

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APPENDIX B

Forage Production and Trends in the Missouri River Breaks, 1976 - 1980

by

Henry E. Jorgensen

INTRODUCTION

This study of production of grasses, forbs, and browse on selected habitat types within the Missouri River Breaks study area was established in 1976 to evaluate the response of various forage classes and species to weather conditions. Through June 1980, the study was conducted within the framework of statewide habitat sutdies to evaluate existing range survey methods, concepts and criteria and develop practical methods of monitoring condition trends on big game ranges. During 1980, the study was included as part of investigations of population ecology and habitat relationships of mule deer in the Missouri River Breaks. This report presents results of clipping studies during the summer of 1980 in relation to those of previous years.

Procedures followed those described by Jorgensen and Mackie (1978). Plots in two stands of the big sagebrush/bluebunch wheatgrass habitat type were clipped and two transects were measured in different stands of the Douglas fir/chokecherry habitat type.

RESULTS

The production of grass, of all the categories of vegetation sampled in this study, is the most similar between macroplots (sample sites) and appears to be most consistently related to variations in moisture conditions between years. Grass production (Table 1) in both macroplots was very similar to production in 1977, both years being significantly less productive than any of the other three years of measurement. The production of forbs (excluding sweetclover and toadflax) in 1980 seems to be more similar to 1976 than 1977, although firm conclusions are difficult to make due to a lack of significant differences between most years. The more heterogeneous distribution and lower abundance of forbs compared to grasses in these study plots means that their production was not as intensively sampled, although it is apparent that forbs are responding differently than grasses to weather conditions.

In 1980, as in previous years, production of *Comandra umbellata* was not significantly different than other years.

Yellow sweetclover production in 1980 was extremely low. The relationship of sweetclover production to weather conditions is unclear, but it is apparent that periods of two or more years in length are important when considering the influence of weather.

Dry matter production of big sagebrush flower leaders was relatively high in 1980 in contrast to the production of other types of vegetation.

Dry matter production of rose, snowberry, chokeberry, and skunkbush sumac in 1980 generally appeared lower than in all other years of measurement with some exceptions. The production of some of these shrubs was lower in 1977 than in 1980 tending to indicate that 1977 and 1980 were very similar as with grasses (see Table 2).

Table 1. Current annual production on two sites in the sagebrush/bluebunch wheatgrass habitat type, Missouri Breaks, 1976-1980.

	Stand 1					Stand 2				
Species[1]	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
COUM	85[2]a	101a[3]	87a	87a	56a	162a	135a	197a	182a	139a
MEOF	15	≈0	72	464	0.62	0.3	≈0	11	0.4	≈0
FORBS	16a	10a	72b	8a	12a	15a	4a	116b	10a	14a
GRASS	291a	236ac	550b	288a	178c	461a	272b	1030c	437a	251b
ARTR[4]	8a	30b	ND[5]	3c	30b	11b	8a	ND	5a	13b

[1]Species abbreviations: COUM: *Comandra umbellata* (bastard toadflax)
MEOF: *Melilotus officinale* (yellow sweetclover)
ARTR: *Artemisia tridentata* (big sagebrush)

[2]Kilograms per hectare.

[3]Letters denote significant or nonsignificant differences between years. The same letter for any of the years means that the differences were not significant and vice versa.

[4]Flower leaders only.

[5]No data collected.

Table 2. Current annual production of shrubs in the Douglas fir/chokecherry habitat type, 1976-1980.

	Stand 3[1]					Stand 4[2]		Stand 5[3]				
Species	1976	1977	1978	1979	1980	1976	1977	1976	1977	1978	1979	1980
RONU[4]	38[5]	17	223	87	7	29	51	30	11	42	23	13
SYOC	28	8	36	52	25	42	64	11	10	20	13	10
PRVI	ND	13	24	88	17	ND	40	ND	32	46	65	25
RHTR	39	27	136	204	37	-	-	1	16	16	34	8
RISE	-	-	-	-	-	1	2	-	-	-	-	-

[1]East of Haines Ridge.

[2]Near Phillips Coulee: discontinued after 1977.

[3]West end of Sand Creek Trail.

[4]RONU: *Rosa nutkana* (Rose), SYOC: *Symphoricarpos occidentalis* (snowberry), RISE: *Ribes setosum* (gooseberry), PRVI: *Prunus virginiana* (chokecherry), RHTR: *Rhus trilobata* (skunkbush sumac).

[5]Kilograms per hectare.

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STUDY NO. BG-1.0 JOB NO. 1 (Supplement)

JOB TITLE: Behavior and survival of mule deer fawns during summer in the Missouri River Breaks, Montana.

JOB OBJECTIVES: 1. To determine the extent, timing and causes of summer fawn mortality in the Missour River Breaks; and

2. To determine the movements, home ranges, activity habits, habitat use and other behavioral characteristics of mule deer fawns and relate those variable to mortality.

INTRODUCTION

In the Missouri River Breaks, mule deer numbers declined sharply during 1971-73 (Mackie 1976). The initial decrease was attributed to the combined effects of a severe winter in 1971-72 and poor spring-early summer conditions in 1971 and 1972 (Mackie 1973). Fawn recruitment, however, and the population continued to decline and/or remained low through the next several years despite average or above-average spring-summer precipitation and mild, open winters (Hamlin 1978).

In 1975 an intensive investigation was initiated to determine causes for the continued low production or survival. Early fall and winter population surveys showed only moderate fawn:doe ratios (Hamlin 1977). Although predation was suspected as one possible cause for low fawn survival, no data were available to evaluate its importance. For this reason, a graduate research study was conducted during the summers of 1976 and 1977 to evaluate the extent and causes of summer fawn mortality as a factor in low fawn survival (Dood 1978). I continued those studies during the summers of 1978, 1979, and 1980 to further evaluate the extent and causes of neonatal mortality under changing population and environmental conditions.

STUDY AREA

The study area, approximately 30,000 Ha in size, is located in north-central Montana, 40 km northeast of the town of Roy. It is bordered on the north by the Missouri River, on the south by the Musselshell Trail, on the west by highway 191, and on the east by the Skyline Trail.

The area is primarily timbered "breaks" terrain, and has been discussed extensively by Mackie (1970). Allen (1968) described the adjacent Missouri River bottomlands encompassed within the study area.

METHODS

Neonatal mule deer fawns were captured using a technique described by Dood (1978). When possible, attempts were made to capture neonates belonging to marked adult does. Captured fawns were processed quickly and carefully to minimize the negative effects of handling. Each fawn was sexed, weighed, examined for wounds or other irregularities, and the overall condition of the animal was noted. The animals were then fitted with a radio transmitter collar, and numbered metal ear tags.

The radio transmitters (Wildlife Materials Inc., LP-21200-LDA) were in the 150-152 Mf^3 range, and were equipped with two 1,200 milliamp lithium batteries. Each radio had an external whip antennae, and a motion-sensitive switch. The radio package was attached to an expandable, elastic neckband with several breakaway folds sewn into it.

Tracking of marked fawns was done primarily from the ground, using an AVM portable radio receiver and a directional Yagi antennae. A fixed wing aircraft (Piper Supercub) was used to locate animals during periods of impassable roads. The location of each fawn was fixed on regular 2-3 day intervals throughout the period of June 15 - Sept. 15. Attempts were made to make visual sightings of the fawns during each relocation. Upon relocation of a fawn, the following data were recorded: map location, activity, proximity to the fawn's dam and other animals, habitat occupied, actual vegetation utilized, aspect, slope, position on slope, and the general condition of the animal. During this study, classification of habitat types followed Mackie (1970). Locations were plotted on an air photo grid. Home ranges were then determined using the modified minimum area method (Harvey and Barbour 1965).

Visual horizontal cover consisting of both vegetation and topography at fawn bedsites was measured using a 3x6 dm coverboard (Nudds 1977). The board was divided from top to bottom into 6 1-dm tall bands of alternating red and yellow colors. Measurements were taken from 3 directions and from a distance of 6 m from the board. The visual environment of a predator is different from that of a human since it is looking through cover at a lower height. For this reason, readings were taken from 2 heights, standing (170 cm), and 50 cm. The amount of cover was estimated to the nearest 5 percent.

When dead fawns were located, the immediate area was extensively searched for possible evidence to the cause of death. Coyote scats, if present, were collected and analyzed for content. Criteria for cause of death followed that described by White (1973), Henne (1975), and O'Gara (1978).

RESULTS

Field work was completed in September, 1980. Currently a final thesis report is being prepared to be submitted as a supplementary research report during early winter. An abstract of that report will be included in the 1982 Montana deer studies report.

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Submitted by: Shawn J. Riley

STUDY NO. BG-2.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the Swan Valley, Montana were continued during 1980-81. Data collected at the lower Swan checking station included information on harvest, hunting and harvest distribution, age structure, and weights and body measurements. The 1980-81 winter was exceptionally mild. Relative to previous winters, a distinct deer concentration did not occur. Age classifications indicated a fawn/adult ratio of 50/100, a recruitment rate similar to that recorded in previous years. Survival rates were estimated from the sample of marked animals and the harvest age structure. Eight deer were equipped with telemetry transmitters. Dispersal was similar to that previously observed. Cumulative information has indicated that the deer population in the Swan Valley is characterized by a stable density. Population stability apparently is an adaptive strategy in response to a predictable habitat associated with the mature coniferous forest. Timber management implications are discussed.

JOB TITLE — Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

JOB OBJECTIVES

1. To determine basic biological and ecological parameters of white-tailed deer populations associated with coniferous forest habitats in northwestern Montana;

2. To relate those basic parameters to (a) characteristics of individual habitats or environments and (b) specific potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, logging and associated forest management practices, subdivisions and associated human activity, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically for coniferous forest habitats.

INTRODUCTION

The white-tailed deer *(Odocoileus virginianus)* is the most abundant and widely distributed big game species in northwestern Montana. Its distribution is closely associated with the mature coniferous forest. Recent trends have indicated reduced populations, concurrent with the development of large areas of deer habitat for other values.

Montana Statewide Deer Research included a study to evaluate factors affecting white-tailed deer in the Swan Valley. That area long has been an important deer range and is representative of a major ecological type in which white-tailed deer occur. The study has emphasized the collection of information basic to the distribution, movements, habitat use, and population dynamics.

STUDY AREA

The study area occurs in southeastern lake and northeastern Missoula Counties. The Swan River Valley lies between the Swan Range and the Mission Mountains and extends from the Swan-Clearwater Divide north, approximately 40 miles, to Swan Lake (Fig. 1). The primary winter range lies between Goat Creek and Condon. Condon is approximately 70 miles northeast of Missoula and 65 miles southeast of Kalispell.

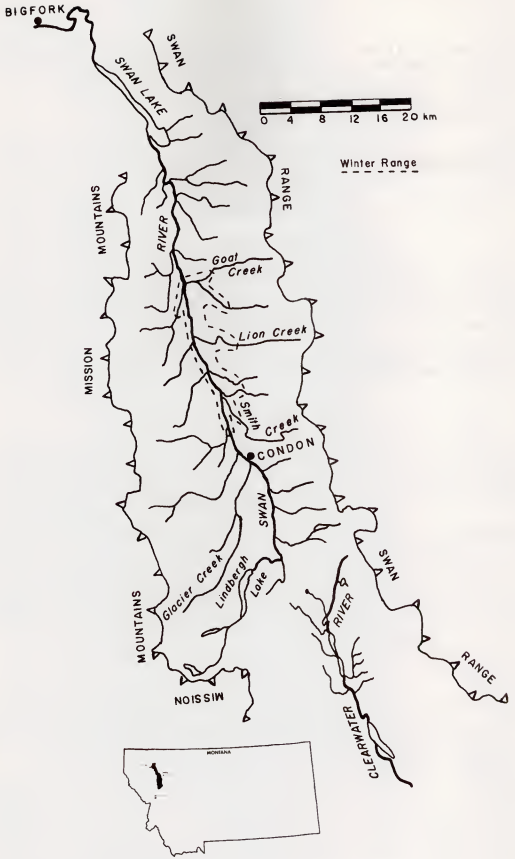

Figure 1. Map of study area.

Hildebrand (1971) and Antos (1977) described the Swan Valley. The history of the deer population and summaries of early studies were presented by Weckwerth (1958), Hildebrand (1971), and Mundinger (1976).

METHODS

Methods employed in the study were described previously (Mundinger 1980).

RESULTS

Hunting Season

The 1980 hunting season in the Swan Valley spanned 6 weeks. This included 8 days of either-sex and 5 weeks of males only hunting. Hunting season parameters, as determined from the lower Swan Check Station and the Montana big game questionnaire,are presented for the 1975-80 hunting season in Table 1.

Four marked deer were harvested and reported during the 1980 season. One radio-collared doe apparently was illegally killed.

Weights and Measurements

Hog-dressed weights and body measurements were collected at the check station. Data from the six hunting seasons were pooled (Table 2). These indicated that size and weight of females increased through at least $3\frac{1}{2}$ years, while those of males increased through $5\frac{1}{2}$ years.

Fawns in the 1979 year-class were lighter and smaller than those in other year-classes (Tables 3 and 4). Few statistically significant differences ($P < 0.10$) were evident from between year comparisons, as sample sizes were small while variances were large. Yet, the differences were consistent. Moreover, yearlings that were harvested in 1980 (the 1979 year-class) also were lighter and smaller (Tables 5 and 6). These differences may have been related to the severity of the 1978-79 winter.

Age Data

The age distributions of the 1975-1980 white-tailed deer harvests are presented in Table 7. In addition to those animals, the samples also included 30, 7, 7, 9, 18 and 6 adult deer for 1975, 1976, 1977, 1978, 1979 and 1980, respectively, for which age could not be determined.

The jaw collection provided a comparison of eruption-wear (Severinghaus 1949) and cementum analysis (Gilbert 1966) as methods for determining the age of white-tailed deer (Table 8). That sample included 11 known-age animals. The ages of seven $2\frac{1}{2}$-year-olds were correctly determined by eruption-wear; one of those was incorrectly assigned to the yearling class

Table 1. Summary of 1975-1980 hunting seasons in the Swan Valley.

	1975	1976	1977	1978	1979	1980
Season Format	10/19-	10/24-	10/23-	10/22-	10/21-	10/19-
Either sex	11/9	10/31	10/30	10/29	10/28	10/26
Males Only	11/10-	11/1-	10/31-	10/30-	10/29-	10/27-
	11/23	11/28	11/27	11/26	11/25	11/30
Hunter Days						
Questionnaire	40,511	33,606	39,691	31,653	30,914	28,244
Check Station	2,750	3,317	3,239	3,016	2,640	2,959
White-tail Deer Harvest						
Questionnaire	635	523	736	625	612	746
Check Station	98	104	154	124	150	208
Mule Deer Harvest						
Questionnaire	70	94	86	69	96	124
Check Station	13	15	24	12	12	28
Elk Harvest						
Questionnaire	293	125	222	135	123	155
Check Station	51	29	39	29	29	35
White-tail, % adult males						
Questionnaire	55	74	79	79	67	71
Check Station	49	66	68	66	41	53
Deer Hunters (Questionnaire)	4,501	3,673	4,323	3,779	3,647	3,704
% Deer Hunter Success (Questionnaire)	17	17	20	18	20	24

Table 2. Average hog-dressed weights and body measurements of white-tailed deer harvested in the Swan Valley, 1975-80.

Sex	Age	Weight (lbs.)	Length cm	Height cm	Hind foot cm	Sample size
Females	½	57.2	114.4	77.5	40.8	48
	1½	95.7**	133.6**	88.9**	45.6**	41
	2½	105.7**	140.8**	91.4**	46.5**	40
	3½	112.9**	144.2*	92.7	47.0	17
	4½	115.6	144.5	92.2	46.8	14
	5½	111.2	140.0	93.8	45.5	5
	6½	115.3	144.8	92.1	46.8	6
	7½	108.8	138.3	93.5	46.5	3
	8½	120.3	144.3	92.6	46.6	7
	9+	110	145.5	95.0	46.6	8
Males	½	63.0	116.4	80.3	42.0	44
	1½	112.6**	140.9**	93.8**	47.7**	154
	2½	144.4**	150.3**	99.5**	49.5**	66
	3½	160.5**	158.4**	102.6**	49.6	36
	4½	177.7**	158.9	104.2	49.9	23
	5½	192.4**	164.9**	103.8	50.6	14
	6½	187.9	163.2	106.0	49.8	10
	7½	185.9	166.2	104.9	50.0	10
	8½	189.1	165.7	102.7	50.6	5
	9+	177.4	160.3	102.9	49.3	5

** Significantly greater, $P < 0.05$, than preceding number in column.
* Significantly greater, $P < 0.10$, than preceding number in column.

Table 3 . Average hog-dressed weights and body measurements of fawns.

Females	1979	1976	1980	1976-78 & 80 Ave.
Weight	54.7	58.1	60.3*	58.5*
Length	114.4	114.4	115.3	114.4
Height	76.4	78.7	78.3	78.1
Hind Foot	40.3	40.6	41.0	41.1

Males	1979	1976	1977	1978	1980	75-78,80 Ave.
Weight	58.5	63.3	66.8*	64.1	64.9	64.8*
Length	114.8	117.1	115.6*	116.9	120.0	117.1
Height	78.9	76.4	83.0*	79.6	82.14	80.9*
Hind Foot	41.3	41.9	42.6	42.4	42.2	42.3

* Significantly larger, $P<0.10$, than 1979 value.

Table 4 . Average hog-dressed weights and body measurements of yearlings.

Females	1980	1976	1977	1978	1979	76-79 Ave.
Weight	90.7	94.5	100.9*	99.3	95.5*	97.1*
Length	130.8	133.8	132.2	132.2	138.0	134.3
Height	89.7	84.8	89.3	91.8	89.4	88.7
Hind Foot	45.4	45.1	46.2	45.4	45.7	45.6

Males	1980	1976	1977	1978	1979	76-79 Ave.
Weight	108.1	111.1	113.8*	115.9*	111.8*	113.8*
Length	139.9	139.6	141.6	140.7	142.4	141.2
Height	93.0	92.0	94.7*	95.1	94.3	94.3
Hind Foot	47.4	47.6	48.1*	47.7	47.5	47.8

* Significantly larger, $P<0.10$, than 1980 value.

Table 5. Percent composition, by age-class, of the white-tailed deer harvest in the Swan Valley, 1975-80.

Age-Class	Females						Males						Total					
	1975	1976	1977	1978	1979	1980	1975	1976	1977	1978	1979	1980	1975	1976	1977	1978	1979	1980
½	30	14	31	26	26	21	14	12	11	12	22	13	20	12	18	16	24	16
1½	13	57	17	31	16	29	33	39	46	45	41	49	25	43	37	41	30	41
2½	17	14	25	15	26	14	25	22	16	22	16	12	22	21	19	20	21	13
3½	9		5	10	14	9	8	4	11	9	8	10	8	3	9	10	11	10
4½	9	5	9		9	8		8	10	2	1	5	3	7	10	1	5	6
5½			2	5		5	8	3	1	5	3	5	5	2	1	5	2	5
6½	9	5	3	3	3	4		4	3		4	2	3	4	3	1	3	3
7½	9			5		4	6	3		2	2	2	7	2		3	1	3
8½		5	3	5	1	1	6	4			1	1	3	4	1	1	1	1
9½						1		1		1				1		1		0.5
10½			3			1			1		1	1			2		1	1
11½					1	1				1						1	1	0.5
12½					1	1											1	0.5
13½	4												2					
14½			2		3										1		1	
Sample size	23	21	64	39	77	77	36	76	135	97	98	125	59	97	199	136	175	202

Table 6. Comparison of age determinations by tooth eruption and wear with age determinations by dental cementum.

Assigned age by dental cementum	Assigned age by tooth eruption and wear									Sample size
	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	
$1\frac{1}{2}$	2									2
$2\frac{1}{2}$	95	7								102
$3\frac{1}{2}$	5	49	5							59
$4\frac{1}{2}$		23	12	4	3					42
$5\frac{1}{2}$		6	7	6	3	1				23
$6\frac{1}{2}$		2	6	11	3		1			23
$7\frac{1}{2}$			5	5	1	4				15
$8\frac{1}{2}$			5	5	2	1	1			14
$9\frac{1}{2}$				1			1		1	3
$10\frac{1}{2}$				2	1	2	1		1	7
$11\frac{1}{2}$						1	3			4
$12\frac{1}{2}$					1	1	1	1		4
$13\frac{1}{2}$						1				1
$14\frac{1}{2}$						1			2	3

Table 7. White-tailed deer fawn/adult ratios in the Swan River Valley, 1958-1981.

Year	Adults	Fawns	Fawns/ 100 adults	Percent Fawns
1958	167	99	59	37
1959	207	68	33	25
1960	77	30	39	28
1961	19	8	42	30
1962	80	33	41	29
1963	59	31	53	34
1964	234	90	38	28
1965	188	108	57	36
1966	33	17	52	34
1967	51	26	51	34
1968	30	26	80	46
1969	122	55	45	31
1970	249	112	45	31
1971	66	28	42	30
1972	42	13	31	24
1976	1,519	600	39	28
1977	2,429	1,010	42	29
1978	2,707	1,295	48	32
1979	2,224	840	38	27
1980	2,276	1,163	43	29
1981	155	78	50	33

Table 8 . Fate of animals within yearly samples of marked deer.

A. Number of known survivors

Sample Year	Sample Size	1976	1977	1978	1979	1980
1976	115	86	57	31	20	10
1977	69		40	23	15	7
1978	118			100	62	38
1979	109				69	39

B. Number of known mortalities

Sample Year	Sample Size	1976	1977	1978	1979	1980	Total
1976	115	3	11	12	2	1	29
1977	69		4	7	4	2	17
1978	118			7	5	6	18
1979	109				5	5	10

C. Number of unobserved animals

Sample Year	Sample Size	Year of Last Observation					
		Never	1976	1977	1978	1979	Total
1976	115	26	18	14	9	9	77
1977	69	25		10	4	6	45
1978	118	11			33	18	65
1979	109	35				25	62

by cementum analysis. The ages of two $3\frac{1}{2}$-year-old deer were correctly determined by both methods. The ages of one $4\frac{1}{2}$-year-old and one $5\frac{1}{2}$-year-old were correctly determined by cementum analysis; each had been assigned to the $3\frac{1}{2}$-year-old class by wear characteristics.

Winter Distribution and Range Use

Winter distribution and range use previously were reported (Mundinger 1980). The 1980-81 winter was exceptionally mild, characterized by warm weather, a few mild storms, and the absence of persistent snow cover.

Deer movement toward the winter range was apparent, but a distinct winter concentration did not occur. Many deer remained on summer range or in areas peripheral to the winter range throughout the winter.

Eight does, which had been trapped in previous years, still carried functional transmitters during the 1980-81 winter. Of those, two returned to the general area of previously used winter home ranges. Two wintered in previously identified intermediate ranges. Two remained on their respective summer ranges throughout the winter. Two deer wintered on summer range, but in areas in which no locations for those deer previously had been determined.

Range use patterns during 1980-81 were similar to those determined during 1976-77. While deer primarily were associated with the mature, coniferous forest, they did forage in recent clearcuts. Consistently used areas were characterized by dense regeneration and proximity to the mature forest.

Fawn Production

Age classifications of 233 deer were made during winter 1981. The data indicated a fawn/adult ratio of 50.3/100, or a population comprised of 33.5% fawns. The recruitment rate was similar to that observed in recent years (Table 7).

The lack of a winter concentration precluded a large sample of age-classifications. It also precluded the collection of a meaningful sample of fawn production of marked does.

The reproductive potential of the Swan Valley population was determined from a collection of female reproductive tracts (Mundinger 1980). No additional collections were made during 1981 because few highway mortalities occurred.

Survival

Survival was estimated from the sample of marked animals (Mundinger 1980). Those estimates, through spring 1980, were modified as additional marked animals were accounted for during 1980-81 (Tables 9 - 13). Annual survival rates were 54.6%, 69.8%, and 65.2% for all males, all females, and all animals, respectively. Those rates were conservative estimates of survival, because they assumed that all unaccounted animals had died.

Table 9. Annual survival and annual mortality rates of marked male cohorts.

	% Known Survival by Year					% Known Mortality by Year					Age at
Cohort	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980	1 June 80
1975	40	33	80	25	0	0	33	20	25	0	6
1976	77	52	50	29	0	5	19	33	14	0	5
1977		43	64	44	50		0	7	33	25	4
1978			89	50	50			7	6	19	3
1979				59	31				4	19	2

Table 10. Annual survival and annual mortality rates of marked female cohorts.

	% Known Survival by Year					% Known Mortality by Year					Age At
Cohort	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980	1 June 80
1974	80	86	75	78	71	0	7	17	11	0	7
1975	78	58	57	58	86	11	8	19	0	14	6
1976	78	82	66	64	56	6	0	14	4	17	5
1977		76	79	77	74		0	3	3	9	4
1978			87	83	54			9	0	4	3
1979				65	60				9	0	2

Table 11. Annual survival and mortality of marked males by age-class.

	Age-Class					
	½	1½	2½	3½	4½	5+
% known survival	69	48	49	42	17	67
% known mortality	4	11	26	21	17	0

Table 12. Longevity of marked females by age-class.

	% known survival to age-class							% known mortality to age-class:						
Age-Class	1	2	3	4	5	6	7	1	2	3	4	5	6	7
½	77	60	41	23	17			6	7	14	20	28		
1½		78	52	30	13	0			2	9	18	29	56	
2½			65	45	24	23	40			7	16	22	27	10
3½				69	41	37	36				9	17	26	29
4½					62	54	42					12	17	25
5½						81	56						13	11
6½							71							0

Table 13. Longevity of marked 4+-year-old females.

	Years				
	1	2	3	4	5
% known survival to year	71	52	38	19	20
% known mortality to year	6	14	21	24	10

Survival also was estimated from the harvest-age-structure (Table 5) (Eberhardt 1969: 474). Those estimates assumed a constant recruitment rate, uniform survival through all age-classes, and that the sample was representative of the population age-structure.

Fawns were not considered in the analysis of males because the season format precluded a representative sample. The survival rate of all males, yearling and older, was not consistent with the assumption of uniform survival ($P < 0.01$). The survival rate of adult males, $2\frac{1}{2}$-years-and-older, was 0.610 ± 0.040 ($P > 0.10$). The survival rate for all females was 0.702 ± 0.029 ($P > 0.10$).

Movements

Presently, 16 live deer are equipped with functional transmitters. That sample includes three deer which were collared in 1978, 5 from 1979, and 8 which were captured in 1981. Dispersal of the 1981 sample was consistent with that of samples from previous years (Figure 2). Likewise, recovery locations of hunter-killed, marked animals were consistent with previously identified dispersal patterns (Figure 3).

DISCUSSION

Cumulatively, population data indicated that white-tailed deer density in the Swan Valley was stable, and that age-structure, survival, and recruitment functioned interdependently to maintain that stability. The female age-structure was full and pyramid shaped. That age-structure was resilient because survival of 6-month-and-older females was high and uniform. Average recruitment was 0.295 and was sufficient to replace annual attrition because the approximate survival rate was 0.70. Relationships between total fawn production and age-structure (Mundinger 1981) tended to determine constant recruitment. Constant recruitment, associated with high and uniform female survival, reinforced the resilient age-structure.

Diversity was the most prominent characteristic of the winter range. It was an interspersion of two integral habitat components, timbered mesic sites and timbered uplands. Those components likewise were diverse. Riparian zones are classic examples of "edge effect" (Odum 1978: 3). Mature forest uplands were dynamic communities in which change, effected by fire and other agents of attrition, perpetuated diversity. Those communities conformed to a "Shifting-Mosaic Steady State" (Bormann and Likins 1974: 174,175 as cited by Schoen et al. 1981). Ecological stability apparently was an important consequence of diversity. It is my impression that population stability is an adaptive strategy by which deer effectively exploit this predictable habitat.

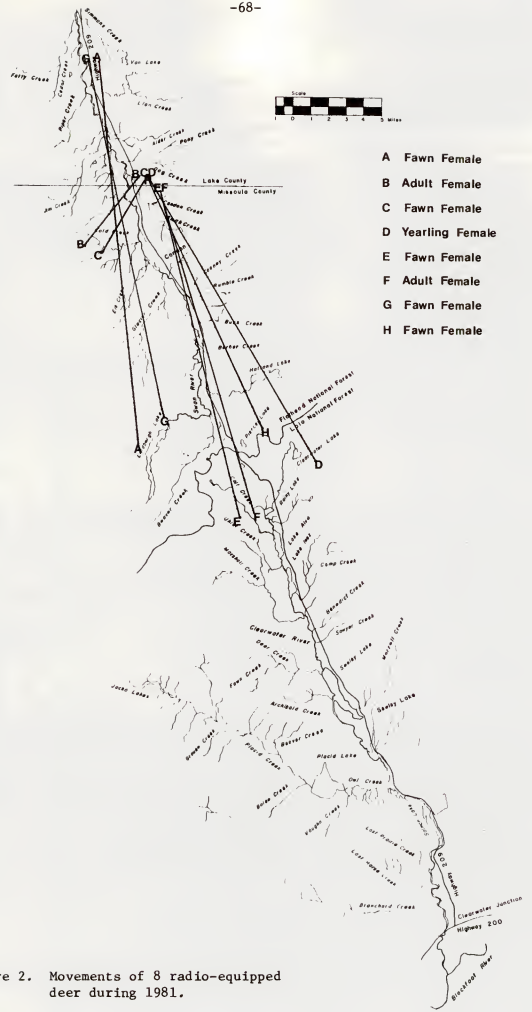

Figure 2. Movements of 8 radio-equipped deer during 1981.

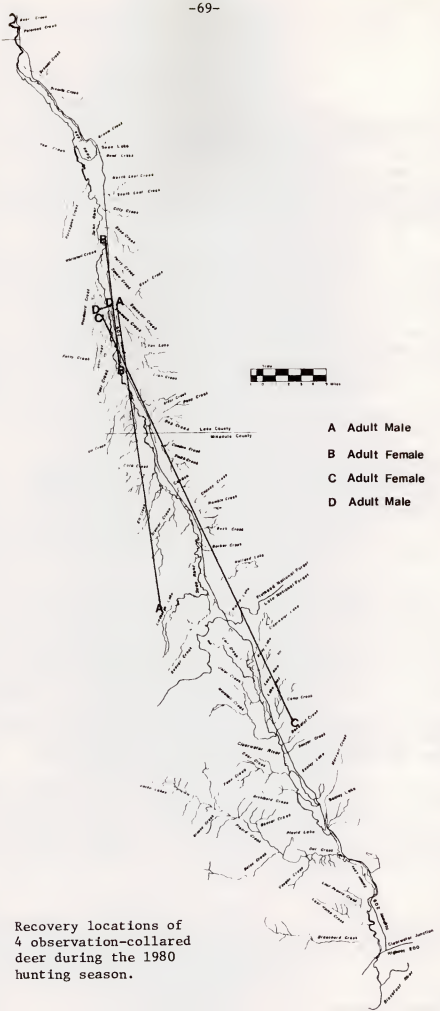

Figure 3. Recovery locations of 4 observation-collared deer during the 1980 hunting season.

MANAGEMENT IMPLICATIONS

Timber production is the dominant land use and recent logging has impacted extensive areas in the Swan Valley. Previous timber sales have reduced the total area of deer habitat because cover was removed, habitat integrity and diversity were disrupted, logging units were large in comparison with home range size, and availability of winter forage was reduced. The loss of habitat was equivalent to the loss of deer because there was no opportunity to produce those animals elsewhere.

Mackie et al. (1980) emphasized the uniqueness of the interaction between an individual deer population and its associated habitat. They further indicated that sudden and drastic changes in the nature of habitat also would disrupt existing deer-habitat interactions. In the Swan Valley, silvicultural systems are, almost exclusively, even-aged. They are intended to facilitate rapid old-growth conversion and an 80- to 120-year rotation-age. The most detrimental aspect of even-aged silviculture is that it imposes on deer habitat an atypical mode of succession. That change represents an extensive reduction in habitat diversity and stability. Such modified habitats will be occupied, if at all, by fewer deer and unstable populations.

Under present direction, additional habitat loss and associated losses of deer are anticipated. Logging of mature, sub-climax forest will continue and the second growth forest will be logged again before succession has progressed to the condition to which deer are best adapted. Similarly, Schoen and Wallmo (1979) indicated that sustained yield timber management on a 100-year rotation would impair sitka black-tailed deer *(O. hemionus sitkensis)* habitat in southeast Alaska forever.

This study could not evaluate specific silvicultural systems because a variety of prescriptions and age-classes were not present. However, obvious detrimental practices were identified. These included: 1) logging units in which a uniform prescription included a diversity of habitat/cover types; 2) logging units which isolated important topographic features; 3) conversion of mixed-aged, old-growth to even-aged, young growth stands; and 4) large clearcuts. These practices should be avoided.

Reasonable alternatives also could be inferred from the observed range use patterns. These should be employed as interim guidelines until deer response to regenerated second-growth can be evaluated.

The integrity of both riparian and upland habitats must be maintained. Thermal cover is essential to both habitats. The winter range cannot simultaneously support white-tailed deer and rapid conversion of old-growth forest. Therefore, the winter range should be designated for special management, withdrawn from the regulated harvest, and managed on an extended rotation (at least 250 years).

Riparian habitat should be managed to perpetuate old-growth. Very light selection is tolerable, but should be employed only to promote specific habitat objectives.

Winter range uplands should be managed to perpetuate mosaic communities of mixed species in multiple age-classes. Logging units should be contained within ecological boundaries. Management should employ selection of group-selection within units of less than 20 acres. Selection should not reduce the overstory below 70% crown closure.

Clearcuts are acceptable only for the conversion of even-aged stands of lodgepole pine *(Pinus contorta)*. There, units should be less than 5 acres and regeneration should feature mixed species.

Logging units should be evaluated with regard to prior activities, both in that unit and in adjacent stands. Subsequent entires must complement previous entries.

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Submitted by: J. G. Mundinger

STUDY NO. BG-2.0 JOB NO. 1 (Supplement)

JOB TITLE: Summer range ecology of white-tailed deer in the coniferous forests of northwestern Montana.

JOB OBJECTIVES: 1. To identify and describe summer habitat of white-tailed deer in the Swan and northern Clearwater River drainages; and

2. To evaluate the possible influences of fire and logging on summer habitat.

INTRODUCTION

Many studies of white-tailed deer have focused on winter range, most commonly considered the weak link in the mosaic of habitats that provide the animals' yearlong requirements. Summer range and the effects of habitat disturbance on summer ranges have received less attention. This study was established during the summer of 1980 to identify and describe summer habitats of white-tailed deer on coniferous-forest-type range in the Swan and Clearwater River drainages in northwestern Montana. A secondary objective was to evaluate the possible influences of fire and logging on summer habitat.

STUDY AREA

The study area comprised the Swan River drainage from the Swan-Clearwater River divide to the mouth of the Swan River at Bigfork on Flathead Lake. The Swan Valley, which is bisected by the Swan River, runs in a north-south direction and is bordered by the Swan Range on the east and the Mission Range on the west.

METHODS

Movements of 10 white-tailed deer, trapped and radio-collared during previous winters, were monitored by telemetry during the summer of 1980. An additional 8 deer were trapped and equipped with transmitter collars during the 1980-81 winter. Home ranges for those deer were delineated in summer 1981. Several deer were monitored for 24 to 48 hours to further define home range boundaries and to establish circadian activity with respect to habitat and cover types.

The 18 individual home ranges delineated have been or will be mapped and described in detail. Cover type, habitat type, percent canopy coverage, topographic features, and successional stages are being determined in the field. Fire and logging histories for the ranges are obtained from U.S. Forest Service and Burlington Northern records.

Due to time constraints, the entire study area can not be mapped in the same detail as the relatively small (less than 160 acre) summer home ranges. Instead, for comparative purposes, I selected and similarly mapped random home ranges that mimic the true home ranges. The random home ranges were generated from data on the average size and location true home ranges. These were placed in available deer habitat within the study area by use of a random number table.

RESULTS

The 10 radio-collared deer monitored during 1980 were relocated a total of 215 times. Of these, 110 were in timbered areas, 83 in riparian areas, and 22 in clearcuts. Deer use of clearcuts seemed limited to units with much cover or riparian habitat.

Continuous relocations of 3 deer over 24-hour periods indicated that all remained within the boundaries of home ranges as previously determined by less frequent observations.

Deer monitored during this study had summer home ranges located south of their winter range in the Swan Valley between Goat Creek and Dog Creek. Six of the deer summered south of the Swan-Clearwater Divide, as far as Lake Inez. Preliminary findings indicate that summer home ranges were predominantly at mid to low elevations and were relatively small, averaging 130 acres in size. They were composed of small activity centers near riparian habitat and comparatively larger foraging areas in upland habitat. Timbered portions are very diverse with respect to habitat and cover types.

FUTURE STUDIES

Field studies will be completed during the summer of 1981. Data will be compiled and analyzed and the final thesis report prepared during fall, winter, and spring 1981-82.

Submitted by: Rosemary H. Leach

STUDY NO. BG-2.0 JOB NO. 3

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in riverbottom habitat in eastern Montana.

ABSTRACT:

A study was initiated during July 1980 to determine factors affecting populations of white-tailed deer *(Odocoileus virginianus)* on bottomlands of the lower Yellowstone River. Three areas, located between Glendive and Sidney, Montana, were selected for intensive study. Population phenomena and habitat usage are described for the biological year ending 31 May 1981. Fawns, yearlings and older deer accounted for 43, 24 and 33 percent, respectively, of the pre-hunt population of fall 1980. Those respective age classes accounted for 11, 42 and 47 percent of the 1980 harvest and 44, 40 and 16 percent of those killed on highways. Of a sample of 133 adult females ($1\frac{1}{2}$+), 68 percent were accompanied by fawns during September and October of which 47, 51 and 2 percent were accompanied by singletons, twins and triplets, respectively. Pre- and post-season fawn/adult ratios were 76/100 and 81/100, respectively. Spring densities of 49 and 45 deer/mi.^{2} were estimated for the Elk Island and Intake study areas, respectively. Weights and condition of hunter-killed deer were also evaluated. Summer home ranges of radioed deer averaged 0.16, 0.07 and 0.09 mi.^{2} for yearling females, adult females ($2\frac{1}{2}$+) and adult males ($2\frac{1}{2}$+), respectively. Respective winter home ranges of yearling and older females were 1.26 and 0.28 mi.^{2}. Two individually marked yearling males were known to disperse 8 and 28 miles from where they were captured. Food habits were evaluated for the period of September through December 1980. Hunter harvest data were evaluated for 1976-80 from the statewide harvest questionnaire and for 1980 from data obtained at checking stations.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in riverbottom habitat in eastern Montana.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of white-tailed deer populations associated with riverbottom/riparian habitat in eastern Montana;

2. To relate those basic population parameters to (a) characteristics of individual habitats or environments and (b) specific, potential limiting factors associated with individual population and habitats, including nutrition, agriculture and associated farming practices, domestic livestock and associated grazing/range management practices, weather, disease, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically for riverbottom habitats.

INTRODUCTION

White-tailed deer *(Odocoileus virginiana)* are primarily associated with riparian communities along major drainages in Montana east of the Continental Divide (Allen 1971). Their distribution in eastern Montana was limited almost exclusively to the Missouri River, its major tributaries and the lower Yellowstone River prior to 1941. Whitetails are now locally abundant also in mountain foothills, prairies and conifer-dominated uplands. Populations of white-tailed deer have been studied on the Missouri River by Allen (1968) and Hamlin (1980) and on the Yellowstone River near Intake by Swenson (1978).

This study was initiated during July 1980 to evaluate ecological relationships and population biology of white-tailed deer along the lower Yellowstone River. The study is one phase of the statewide deer research project. The lower Yellowstone was selected because this area represents a major ecological type on which white-tailed deer occur in eastern Montana. Emphasis is directed at population phenomena, behavior and habitat use, and animal/habitat/environmental interactions. Plant communities and succession along the lower Yellowstone are being described in a concurrent graduate (MS) thesis research study, which is reported separately (Boggs 1981).

STUDY AREA

The lower Yellowstone River study area includes approximately 53 miles of floodplain and islands between Glendive and Sidney, Montana (Figure 1). The river, flowing from southwest-to-northeast, is paralleled by state highway 16. Elevation drops from 2076 feet at Glendive to 1920 feet at Sidney. The study area includes portions of Dawson, Richland and Wibaux Counties and lies entirely in hunting district 750.

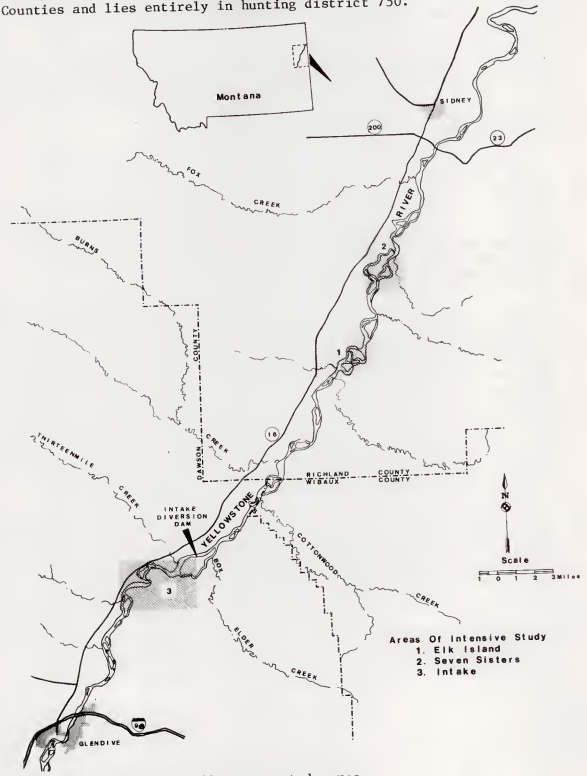


Figure 1. The lower Yellowstone study area.

Agriculture is the principal land use along the Yellowstone Valley and includes production of livestock, forage, and cash crops. The floodplain and adjacent terraces on the northwest side of the river below Intake are intensively cultivated and flood-irrigated from the Lower Yellowstone Project which includes the diversion dam at Intake (Figure 1) and the main U.S. Bureau of Reclamation canal. On this portion of riverbottom, production of livestock is secondary to cash and forage crops. Two of the three intensive study areas occur on this area, the Elk Island area near Savage and the Seven Sisters area near Crane (Figure 1). The Elk Island and Seven Sisters Wildlife Management Areas comprised the core of those two study areas. The third intensive study area was located above Intake on river bottomlands where production of livestock and supplemental forage crops are major agricultural activities. Baseline wildlife data were previously gathered in that vicinity (Swenson 1978a).

Physiographic features in the vicinity of the study area consist of: rolling uplands, which include glacial till and alluvial deposits; high benches among the rolling uplands; and, the floodplain of the Yellowstone River and its principal tributaries (Montana Water Res. Bd. 1970). Sandstone, shales and coal seams of the Fort Union Formation are intermittently exposed along the Yellowstone Valley. Soils of the low stream terraces and alluvial plains include those of the Trembles-Havrelon and Cherry Associations (Holder and Pescador 1976).

Swenson (1978a) subjectively described plant communities in the rolling uplands and floodplain in the study area above Intake. The bottomland communities are represented throughout the portion of the drainage presently being investigated. Communities on the floodplain include riparian forest, rose-snowberry, silver sagebrush-grassland, hay meadows and croplands. Upland communities include grassland, hardwood draws, juniper breaks and non-irrigated cropland. I distinguished homogeneous stands of plains cottonwood *(Populus deltoides)* and green ash *(Fraxinus pennsylvanicus)* which comprised the riparian forest community. Cottonwood was further distinguished on the basis of relative age of individual stands: seedling, young, submature, mature and decadent. Descriptive criteria for aging these stands are being developed (Boggs 1981).

The climate is Continental with marked variation in seasonal precipitation (Montana Water Res. Bd. 1970). Approximately 80% of annual precipitation normally falls from April to September. Snowfall averages 28 inches annually along the Yellowstone Valley; significant accumulations are rare. The frost-free period along the valley floor near Glendive is 130 days. Monthly climatological data were taken from records at Glendive, Savage and Sidney weather stations (U.S. Dept. Comm. 1980, 1981). Winter severity indices (WSI) (Picton and Knight 1969) were calculated from data recorded at Sidney for the period of 15 November to 31 March. The winters of 1979-80 and 1980-81 were abnormally mild and snowfree (WSI's 1,565 and -600), whereas the winter of 1978-79 was abnormally

severe (WSI 24,028). Monthly temperature and precipitation data for the period of June 1980 through May 1981 appear in the Appendix, Table 12.

METHODS

Data on herd composition, fawn production and recruitment for the biological year ending 31 May 1981 were obtained from fixed-wing aerial surveys during September-October (pre-hunt), January (post-hunt) and March-early April. The entire riverbottom from Sidney to Glendive was surveyed during January. Only the 3 areas selected for intensive study (Fig. 1) were surveyed during fall and early spring. An estimate of the proportion of the female segment ($1\frac{1}{2}$+ years) producing fawns was made from observations of does with fawns at heel during fall. Miscellaneous production data were obtained while pursuing other activities. When possible, reproductive success was determined for individually marked females.

Age structure of the population was further evaluated from samples of deer harvested by hunters, road-killed deer and animals trapped for marking. The age of each deer harvested was assigned by criteria of eruption and wear of mandibular dentition (Severinghaus 1949). Middle incisors were extracted from dead animals, classified as $2\frac{1}{2}$-years-old and older, for aging by a cementum analysis technique (Gilbert 1968).

From late February to early April 1980, 29 whitetails were captured and individually marked for study on the Elk Island and Seven Sisters study areas. From late December 1980 to late March 1981, 45 additional deer were captured and marked on those areas and the Intake study area. Capture was accomplished using Clover traps (Clover 1954) and cannon nets (Hawkins et al. 1968). Animals were equipped with either transmitter collars or with individually recognizable collars. Numbered metal tags were affixed to the ear(s) of all deer marked and released. Aerial relocations of radioed deer were obtained at approximately 10-day intervals beginning in June 1980. The aircraft used was a PA 18 (150 hp) Super Cub with a 3-element Yagi antenna attached to the strut. Sightings of individually recognizable collared deer were recorded incidental to relocating radioed deer or while conducting other field activities.

Numbers of deer on the Elk Island study area were estimated during October 1980 and March 1981 using a Lincoln Index (Davis and Winstead 1980). A population estimate was also made for the Intake study area during March 1981.

All observations of deer during aerial surveys were located and plotted, either on aerial photos or on topographical maps of the riverbottom; a brief description of the surrounding habitat was also made. The same

information was recorded for relocations of marked deer. An attempt was made to evenly distribute relocations of radio-equipped deer throughout diurnal hours which were split into 3 periods: < 1000 hrs.; 1000 to 1600 hrs.; and > 1600 hrs. Observations of movements and habitat use during hours of darkness were made incidental to trapping and during evening vehicle reconnaissance. All relocations were entered on a computer file for future retrieval and analysis.

Harvest information for hunting district 750 was obtained through checking stations at Crane and Glendive on the first and last days of the 1980 deer hunting season. Comparative data were obtained for hunting district 714, which consists entirely of bottomlands of the Yellowstone River from Custer to Miles City, from checking stations near Hysham and Custer. In addition to determining composition of the harvest by sex and age, diastemal and antler measurements were recorded for all yearling males to evaluate growth and condition (Swenson 1980). Field-dressed weights were obtained from 16 deer checked at Crane. Additional sex and age data were obtained through field reconnaissance and through correspondence to special permit holders. Total harvest of white-tailed deer and hunter success were obtained through the statewide harvest questionnaire.

RESULTS

Population Characteristics

Composition by Sex and Age

White-tailed deer in the lower Yellowstone Valley were relatively young animals (Figure 2). Deer aged 4½ years and younger comprised 89% of the pre-hunt population; nearly half of those were fawns. Pre-hunt herd composition as determined from aerial surveys is shown in Table 1. The age composition of females older than fawns and males older than yearlings in the harvest is presented in Table 2. These 76 harvested deer comprised 12% of the estimated 1980 whitetail harvest in hunting district 750. The age and sex composition of deer harvested in hunting district 714 appears in the Appendix, Table 13.

Other data on the sex and age structure of the population in the lower Yellowstone Valley were obtained from 80 deer captured over 2 years (Table 3) and from 25 deer killed on highways since July 1980 (Table 4). Fawns occurred among those samples in proportion to their relative abundance in the population. However, the ratio of males to females among fawns was 60:100, 200:100 and 57:100 in samples of harvested, trapped (1981) and road-killed deer, respectively, suggesting that male fawns were more trap prone than were females. The number of fawns in samples of harvested and road-killed deer was less than 10 in each case, and a departure from a 1:1 ratio by one animal would distort these ratios. When harvest data for hunting districts 750 and 714 were combined, the 2 sexes of fawns occurred at a ratio of 1:1. Because of this, I assumed that male and female fawns occurred in the pre-hunt population at a nearly equal ratio (Figure 2), although some departure may have existed. Yearlings and

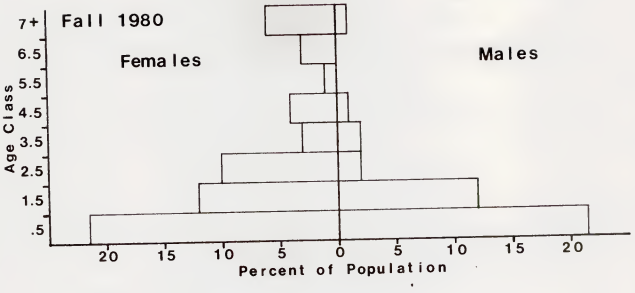


Figure 2. Composition by sex and age of the pre-hunt population during fall 1980.

Table 1. Pre-hunt herd composition of white-tailed deer in hunting district 750 from 1977-80.

Year	Number Classified	Percent Males 2½+	Percent Males 1½	Percent Females 1½+	Percent Fawns	Fawns: 100 Fem. 1½+	Fawns: 100 Ad. 1½+
1977[a]	375	10[b]	--	53	37	68	58
1978	42	7	--	43	50	117	100
1979	125	14	--	36	50	140	102
1980[c]	540	6	12	39	43	112	76

[a]Data were from Region 7 annual job progress reports (Swenson 1978b), Swenson and Knapp 1979, Swenson 1980).

[b]Yearling and older males were not separated in the samples of 1977-79.

[c]Data for 1980 is from the ongoing study exclusively along bottomlands of the Yellowstone River.

Table 2. Percent composition by age of 76 white-tailed deer harvested in hunting district 750 during 1980.[a]

Age Class	Females (33)	Males (43)	Total (76)
½	15	7	11
1½	27	53	42
2½	21	16	18
3½	6	16	12
4½	9	5	7
5½	3	--	1
6½	6	--	2
7½	12	2	5

8 fawns:68 adults = 12:100
8 fawns:28 adult females = 29:100
yearlings = 32% of adult females
yearlings = 57% of adult males
23 yearling males:9 yearling females = 256:100, or 72% males
17 2½+ males:19 2½+ females = 89:100, or 47% males

[a]Data from checking stations and jaw collections are combined.

Table 3. Percent composition by age of 80 white-tailed deer trapped in hunting district 750 during 1980-81.

	Females		Males		Total	
	1980	1981	1980	1981	1980	1981
Age Class[a]	(18)[b]	(27)	(15)	(20)	(33)	(47)
½	44	26	87	70	64	45
1½	6	15	--	30	3	21
2½	17	26	--	--	9	15
3½	11	7	7	--	9	4
4½	11	7	--	--	6	4
5½	6	11	--	--	3	6
6½	--	4	7	--	3	2
7½	6	4	--	--	3	2

21 fawns:26 adults = 81:100[c]
21 fawns:20 adult females = 105:100
yearlings = 20% of adult females
yearlings = 100% of adult males
6 yearling males:4 yearling females = 150:100, or 60% males

[a]Age was determined entirely by eruption and wear patterns.
[b]Sample size is in parentheses.
[c]Includes animals trapped only during biological year 1981.

Table 4. Percent composition by age of 25 white-tailed deer killed on highways along the Yellowstone River during biological year 1980-81.[a]

Age	Females (17)	Males (8)	Total (25)
½	41	50	44
1½	35	50	40
2½	12	--	8
3½	--	--	--
4½	12	--	8

11 fawns:14 adults = 79:100
11 fawns:10 adult females = 110:100
yearlings = 60% of adult females
yearlings = 100% of adult males
4 yearling males:6 yearling females = 67 males:100 females or 40% males

[a]Sample from hunting districts: 750 (80%); and 730, 714 and 761 (20%).

older deer appeared more vulnerable to hunting mortality than fawns, since age classes older than fawns contributed 89% of the harvest (Table 2) but accounted for only 57% of the pre-hunt population (Figure 2). This phenomenon was likely due to selectivity by hunters for adult deer as reported by Roseberry and Klimstra (1974). Yearlings accounted for 24% of the pre-hunt population with males and females occurring at a ratio of nearly 100:100 (Figure 2). Yearling males outnumbered females in the harvest at a ratio of 256:100 indicating a disproportionate vulnerability of males to hunting mortality. A similar situation existed among adults older than yearlings, although there was a disproportionate pre-hunt sex ratio favoring females (19:100). Adult males and females (2½+) were harvested at a ratio of 89 males:100 females.

Early winter aerial surveys of January 1981 indicated a slight increase in the proportion of fawns in the post-hunt population as compared to those of September and October (Tables 1 and 5) which reflected the disproportionate harvest of adults over fawns. Some adult males had undoubtedly shed their antlers by the time winter flights were made. Of 86 antlered deer observed, 70% were classified as yearlings based on antler size. This compared to 68% yearlings observed during fall. The antlered harvest consisted of 58% yearlings as determined from data gathered at checking stations and from jaw collections. Flights during early spring indicated no change in fawn:adult composition from early winter (Table 5). The high recruitment rate, 45% fawns, was perhaps influenced by the abnormally mild winter of 1980-81.

Table 5. Post-hunt herd composition of white-tailed deer in hunting district 750 during 1976-77 and 1980-81.

Period and Year	Number Classified	% Adults	% Fawns	Fawns: 100 Adults 1½+
Jan.-Mar.[a] 1977	184	58	42	72
Jan. 1981[b]	687	55	45	81
Mar.-Apr. 1981	425	55	45	82

[a]From Eustace and Swenson 1977.
[b]Data gathered during current study.

Productivity

Observed fawn:doe ratios during fall have exceeded 100:100 since 1978 (Table 1). Aerial observations during fall 1980 indicated that 68% of the adult females (1½+) successfully reared fawns to that time (Table 6). The ratio of fawns:producing females (154:100) resulted in a calculated net production ratio of 105:100. This compared to the observed fawn:doe ratio of 112:100.

Table 6. Fawn production of white-tailed deer in the Yellowstone study area during 1980.[a]

	Fawns:100 Producing Females	% Females Producing	Percent Singles	Twins	Triplets
September-October 1980	154:100 (133)[b]	68[c]	47[d]	51	2

[a]Sample obtained from Elk Island, Seven Sisters and Intake subunits.
[b]Producing female sample size in parenthesis.
[c]Nonproducing females included those observed along, in groups of adults, or believed to be a yearling female accompanying an older female with fawns.
[d]Percent of producing females.

Approximately half the producing females were observed with twin fawns; 2% were believed to have successfully reared triplets. Pac (1978) reported 68% of gravid females from carcass collections in eastern Montana carrying twin fetuses. The comparatively low rate of twinning in the population along the lower Yellowstone, barring any substantial early postnatal fawn mortality, may have been an artifact of the relatively young age structure among females of breeding age. Robinette et al. (1977) reported that productivity of mule deer females increased with age up to about 8½ years.

All 7 radioed adult females (2½+), which were monitored during summer 1980, were believed to have produced fawns. The number of fawns produced was not determined for 2 animals. Both were rarely observed when relocated during summer. One was lactating at the time she was harvested during the archery season in September. The other was occasionally observed with fawns during fall and winter but was also accompanied by other adult deer. Of the 5 does from which the number of fawns was determined, 4 were accompanied by twins and the other by a singleton. All 5 were 3½ years and older. The singleton was believed to have died as a result of crippling during the archery season since the radioed adult female (80-08) left the vicinity during that time and, when subsequently observed, was often alone through late spring 1981. Only 2 of the 4 does accompanied by twins survived through the hunting season and succeeding winter. Both were repeatedly observed with their fawns through spring 1981.

Of 4 radioed yearling females monitored during summer 1980, one produced a single fawn, and the others were non-producers. Three other females of that cohort, which had died incidental to trapping the previous spring, were not pregnant. Thus, although some females born in 1979 bred as fawns and successfully reared young during summer 1980, their overall contribution to annual production of the population was minor. Yearlings accounted for 32% of the adult female segment of the population prior to the 1980 hunting season.

Mortality

Hunting was the largest cause of mortality among individually marked white-tailed deer on the lower Yellowstone during the biological year ending 31 May 1981. Nine of 29 deer (31%) marked prior to summer 1980 were taken by hunters the following fall. This included 2 deer taken during the archery season in September. Of 15 radioed adults (1½+), alive at the onset of the 1980 hunting season, both adult males (2½+), 1 of 5 yearling females, and 3 of 8 older females were harvested. Four of 13 yearling males with observational collars were known to have been taken by hunters. All marked deer known to have been killed were taken in and near the Elk Island and Seven Sisters Wildlife Management Areas, where all marked deer were captured the previous winter and spring. Hunters had unrestricted legal access to the management areas, unlike the entire riverbottom. For this reason, the relative proportion of those age classes of marked deer harvested was perhaps not representative of that throughout the entire hunting unit.

No marked deer were known to have died as a result of crippling. Deer presumed to have died as a result of crippling were evident along the riverbottom during flights made from November through January, though no attempt was made to measure the total number of carcasses.

Five other marked deer were known to have died during the report period, including 3 deer marked during winter and spring 1981. Three of those deaths were presumed to be trap-related, 1 was believed to have drowned, and the other was a road-kill.

As mentioned previously, adults ($1\frac{1}{2}$+) were harvested in greater proportion than fawns, and adult males ($1\frac{1}{2}$+) were killed in greater proportion than females of similar age classes. Yearlings were represented among the sample of road-killed deer in greater proportion than in the pre-hunt population (40 vs. 24%). The sample of road-killed deer did not include any males older than yearlings.

Population Density

Estimates of the number of deer/mi.^{2} were made on an 8.3 mi.^{2} area surrounding Elk Island during October 1980 and on both the Elk Island area and a 10.4 mi.^{2} unit at Intake during March 1981. Population estimates for Elk Island during October and March were 315 and 405 deer, respectively: 4 of 12 and 8 of 24 marked animals known to be on the area were seen during the respective periods. The Standard Error (Davis and Winstead 1980) exceeded 130 in both cases thus giving relatively meaningless confidence limits (0.95). Resulting densities were 38 and 49 deer/mi.^{2} during the respective time periods. An estimated 464 deer occurred on the Intake area where 6 of 13 marked deer were observed. The Standard Error was 187. The calculated density was 45 deer/mi.^{2}.

The calculated densities must be considered only very tentative, since marked deer accounted for less than 10% of estimated numbers of deer in each case, a factor which most likely contributed to the relatively large Standard Errors. It would also seem desirable to obtain a better understanding of behavioral responses of white-tailed deer to this habitat, including seasonal movements by sex and age class, prior to any interpretation of deer densities.

Swenson (1978a) reported a pre-hunt density of about 30.5 deer/mi.^{2} above Intake following an epizootic of hemorrhagic disease during summer and fall 1977 which claimed an estimated 33% of the summer population. Prior to the epizootic, a probable summer density of 45.5 deer/mi.^{2} existed. His population estimate was based on a change-in-ratio of adult males from fall to winter with the number of males harvested roughly known.

Condition

Field-dressed weights taken from deer at the checking station at Crane are summarized in Table 7. Average dressed weights of both yearling males and

females from the Yellowstone River were heavier than average dressed weights of yearlings from throughout Montana as determined from 1948-63 (Mackie 1964) but were comparable to those from the Swan Valley (Mundinger 1980). The average dressed weight of female fawns was comparable to those of the same sex and age class from both statewide averages and the Swan Valley. The largest deer weighed during 1980 was a 4½ year old male weighing 200 pounds.

Table 7. Average field-dressed weights, by sex and age, of 16 white-tailed deer harvested in the Yellowstone Valley during 1980.[a]

Age Class	Weight[b]	
	Females	Males
½	53 (3)[c]	--
1½	98 (3)	115 (5)
2½	--	--
3½	--	138 (3)
4½	105 (1)	200 (1)

[a]All were weighed at the checking station at Crane.
[b]Weight is expressed in pounds.
[c]Sample size is in parentheses.

Antlers and diastemae have been measured on hunter-killed deer in Region 7 since 1978 in an attempt to quantify the relationship between deer populations and their habitats on the premise that these measurements were reliable indices of trends in condition and/or growth (Swenson and Knapp 1979). Diastemal and antler measurements from yearling males, obtained from 1978-80 from 3 different habitats, are summarized in Table 8. The Yellowstone River and the Long Pines unit of the Custer National Forest represented the upper and lower extremes, respectively, in terms of condition indices, a trend which was consistent throughout the 3-year period. Condition indices from deer on the Yellowstone River exhibited less variability between years than either the upland conifer or prairie-agricultural habitats in light of widely varying weather conditions during winters preceeding periods of data collection. This not only reflected physical and vegetal differences between the 3 habitats, but perhaps also, the manner in which deer exploit these diverse environments.

Table 8. Indices of condition for yearling male white-tailed deer in 3 different habitats in eastern Montana.[a]

Index	Year	Yellowstone[b] River Floodplain	Upland[c] Prairie/ Agricultural	Upland[d] Ponderosa Pine
Diastemal Length (mm)	1978	72.0 (6)[e]	70.1 (3)	66.7 (3)
	1979	71.4 (7)	66.4 (5)	60.7 (4)
	1980	71.4 (23)	70.4 (19)	67.2 (4)
	Average	71.6	69.0	64.9
Greatest Main Beam Length (in.)	1978	12.1 (5)	9.6 (3)	5.2 (2)
	1979	10.6 (8)	7.7 (5)	6.2 (4)
	1980	10.8 (25)	11.1 (20)	7.6 (4)
	Average	11.2	9.5	6.3
Average Number of Points[f]	1978	2.4 (7)	2.1 (3)	1.0 (3)
	1979	1.9 (8)	2.3 (5)	1.7 (4)
	1980	2.1 (21)	2.3 (17)	1.4 (4)
	Average	2.1	2.2	1.4
Percent "Spikes (1 x 1)	All Years Combined	12.8 (39)	11.1 (27)	45.5 (11)

[a] From data gathered by Region 7 personnel during the hunting seasons of 1978-80.

[b] Includes hunting districts 714 and 750.

[c] Includes hunting districts 700, 732 and 733.

[d] Includes the Custer National Forest portion of hunting district 781 (Long Pines Unit).

[e] Sample size is in parentheses.

[f] Average number of points per antler excluding brow tines.

HABITAT USE

Distribution

Distribution of white-tailed deer on the riverbottom during the first year of study, which included an abnormally mild and snow-free winter, did not change appreciably over time. Observation and relocation of marked deer indicated that individual deer differentially used their annual home ranges throughout the year, but, spacially, such changes were negligible. Individuals using islands of riparian tree and/or shrub cover along the U.S.B.R. main canal, laterals below the Intake Diversion Dam, or old stream channels during summer and early fall, abandoned those areas during fall or early winter in favor of larger stands of riparian tree cover adjacent to the river channel or on islands in the river. Swenson (1978a) reported the greatest number of deer to occur where hay meadows and grain fields were located near large stands of riparian cover.

Diurnal and nocturnal use of riverbottom habitat differed throughout the year. Diurnal use was restricted almost exclusively to in or near comparatively dense stands of riparian tree and/or shrub cover, whereas deer were observed in relatively large numbers in agricultural fields and other treeless areas during twilight and periods of darkness. On the Intake study area, it was not uncommon to observe deer moving onto winter wheat fields on the upland terraces 1-2 hours before sunset, whereas on the other 2 study areas, such movement usually did not occur until after sunset.

Home Range

Summer and/or winter home ranges were computed for 16 radio-equipped deer from which 5 or more fixes were obtained during either period (Table 9). The sample included 4 yearling females, 9 older females ($2\frac{1}{2}$+), 1 yearling male and 2 older males ($2\frac{1}{2}$+). Seasonal home ranges included the area within polygons formed by connecting the outermost relocations for individual deer. Data gathered during the report period represented activity only during diurnal and twilight periods. Early morning, midday and evening periods accounted for 36, 40 and 24 percent of all relocations, respectively. Yearlong patterns of activity for 4 adult females ($2\frac{1}{2}$+) and 2 yearling females on the Elk Island study area are illustrated in Figures 3 and 4.

Relocations of radioed deer indicated a high affinity for relatively small areas by individual deer during diurnal periods of summer and winter. This was particularly true of adult females ($2\frac{1}{2}$+) during summer (Table 9 and Figure 3). As mentioned previously, all females older than yearlings were either known to, or suspected to, have produced fawns during summer 1980. Summer home ranges of 2 yearling females (Nos. 80-05 and 80-10) were considerably larger than those of older females, whereas

Table 9. Summer and/or winter home range size for 16 white-tailed deer equipped with radio collars on the Elk Island and Seven Sisters study areas during 1980-81.

Serial Number	Age During BY 1980-81	Sex	Study Area	Home Range Size Summer km^2/mi^2	Home Range Size Winter km^2/mi^2
80-05	1½	F	Elk Isl.	0.49/0.19	0.77/0.30
80-10	1½	F	Elk Isl.	0.64/0.25	8/78/3.39
80-17*	1½	F	Elk Isl.	0.18/0.07	-
80-29	1½	F	7 Sis.	0.30/0.12	0.23/0.09
Average				0.40/0.16	3.26/1.26
80-02+	3½+	F	Elk Isl.	0.35/0.14	-
80-03	5½+	F	Elk Isl.	0.13/0.05	0.28/0.11
80-06	5½+	F	Elk Isl.	0.14/0.05	0.23/0.09
80-08	4½	F	Elk Isl.	0.06/0.03	1.89/0.73
80-12	4½	F	Elk Isl.	0.20/0.08	1.41/0.54
80-19*	3½	F	Elk Isl.	0.15/0.06	-
80-20*	2½	F	7 Sis.	0.26/0.10	-
80-26	8½	F	7 Sis.	-	0.37/0.14
81-04	2½	F	7 Sis.	-	0.14/0.05
Average				0.18/0.07	0.72/0.28
80-22*	4½	M	7 Sis.	0.31/0.12	-
80-27*	7½	M	7 Sis.	0.12/0.05	-
81-03	1½	M	7 Sis.	-	0.14/0.05
Average				0.22/0.09	-

* Animals were taken by hunters during fall.
\+ Animal was presumed drowned during December, 1980.

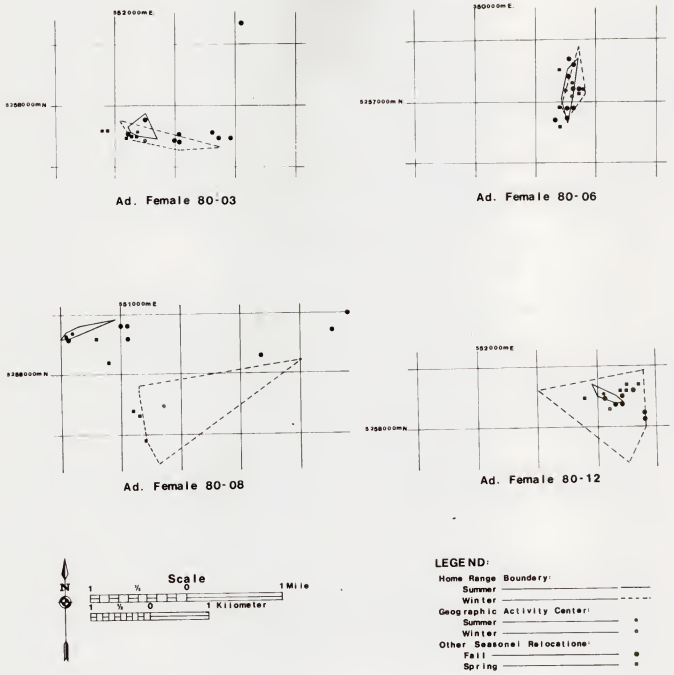
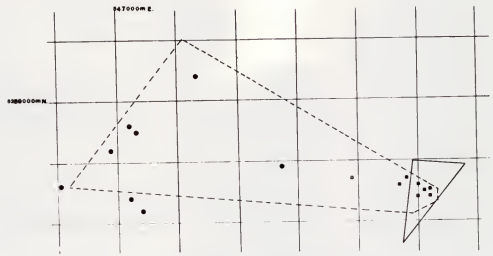
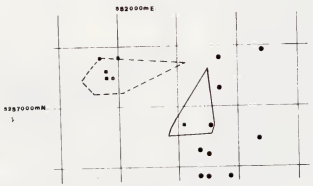


Figure 3. Patterns of seasonal activity of 4 adult females ($2\frac{1}{2}$+) on the Elk Island study area.



Yr. Female 80-10



Yr. Female 80-05

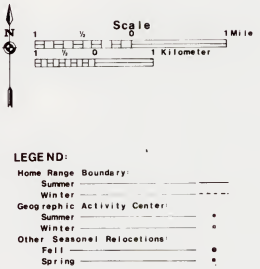


Figure 4. Patterns of seasonal activity of 2 yearling females (both nonproducers) on the Elk Island study area.

that of yearling female 80-29 was only slightly larger than that of most older females. The summer home range of yearling female 80-17, which produced one fawn, was comparable in size to those of older producing females.

In all but one case, winter home ranges of yearling and older females, for which both summer and winter data were available, were somewhat larger than those of the previous summer (Table 9). These data may not be representative of normal winter activity patterns due to the abnormally mild winter experienced in 1980-81. The comparatively large winter home ranges of some females were influenced by movement during December from areas where they had spent the previous fall (Figures 3 and 4). Such shifts were also indicated by geographic centers of activity (Hayne 1949) in relation to home range boundaries.

Activity during fall and spring for some females (1½+) did not indicate any particular affinity to small discrete areas (Figures 3 and 4). Some individuals used portions of their annual home ranges during those periods that were not used during summer or winter (e.g., 80-03, 80-05 and 80-08).

Movements and Dispersal

Of 10 yearling males, with observational collars, marked in the Elk Island study area as fawns the previous winter and spring, 6 were observed in the vicinity of Elk Island during summer 1980. Of these 6, 2 were harvested in the Elk Island study area during fall 1980, one was known to have lost its collar there during January 1981, 2 were observed in that study area through spring 1981 and the status of one is unknown. One of the 4 males not observed following capture was killed by a hunter on Seven Sisters Island. This represented a dispersal of approximately 8 miles north of where the animal was captured. A deer with a collar of the same color combination used on males of that cohort at Elk Island was sighted on the riverbottom 2-3 miles north of Glendive by hunters during late November 1980, although a positive identification was not made. This would represent a movement of approximately 28 miles south from Elk Island study area.

One yearling female (80-10) moved from the riverbottom to the adjacent uplands during early September 1980. She remained there through mid-December when she returned to the riverbottom for the remainder of the winter and spring (Figure 4). An adult female (80-02) moved from her summer home range, located across the river from the north tip of Elk Island, approximately 10 miles south to the mouth of Burns Creek during mid-November 1980. This movement was attributed to hunting pressure in that area. She had returned to her summer home range when relocated one week later. Two adult females (80-03 and 80-12) moved from the floodplain to islands on the river during early September. This perhaps represented a point at which fawns, nearing 3 months in age, were strong enough to negotiate the current of the river. As mentioned previously, adult female 80-08 left her summer home range, located along the U.S.B.R. main canal, during September following the presumed loss of her fawn. She was located on and near Elk Island through the remainder of the fall.

Food Habits

Monthly food habits of white-tailed deer during September-December 1980 are summarized in the Appendix, Table 14. Browse and agricultural crops averaged 40 and 43 percent of the diet, respectively, throughout the fall-early winter period. Snowberry (*Symphoricarpos* spp.) and wild rose (*Rosa* spp.) predominated among browse items in the diet during September and October, whereas plains cottonwood, which consisted mostly of detritus, was comparatively abundant in the samples obtained during November and December. Alfalfa and sugar beets were used most heavily and consistently among agricultural crops. Sugar beets were used most heavily during November and December and presumably consisted of spillage incidental to harvesting of this crop during late October.

Most of the rumen samples, obtained during fall and early winter, were from the section of riverbottom below Intake, and use of agricultural crops by deer reflected those grown in that intensively farmed stretch of floodplain. The volume of agricultural crops in rumens of deer killed on highways were greater than from those killed by hunters. Samples taken during September and November included 1 and 12 hunter-killed deer, respectively, whereas all samples for October and December were from road-killed deer. The data in Appendix, Table 14, suggested that road-killed samples may have included proportionately more deer that are seeking out agricultural crops and/or have comparatively greater access to such areas than the population as a whole. Thus, the source of rumen samples may be an important consideration when interpreting food habit data.

HARVEST

Harvest data for hunting districts 750 and 714, from the statewide deer harvest questionnaire, are summarized in Tables 10 and 11. Approximately 90% of white-tailed deer observed in hunting district 750 in surveys during the winter of 1978-79 occurred along the Yellowstone River; the remainder were observed in the Beaver Creek drainage in Wibaux County (Swenson 1980). It was assumed, therefore, that the reported harvest from hunting district 750 came largely from the Yellowstone River.

White-tailed deer averaged 80% of the total deer harvest from 1976-80, and accounted for the largest proportion of the harvest during 1976 and 1977 (Table 10). This was likely an artifact of comparatively more conservative regulations regarding taking of mule deer (Swenson 1978b) combined with relatively low population numbers of mule deer during that period (Swenson 1980). The proportion of the total harvest in hunting district 714, consisting of white-tailed deer (Table 11), was lower than that in hunting district 750.

The whitetail harvest in hunting district 750 averaged 533 deer/year during 1976-80 with the lowest and highest levels of harvest reported during 1979 and 1980, respectively (Table 10). Numbers harvested also

Table 10. Summary of harvest statistics for hunting district 750 during 1976-80 as determined from the statewide deer harvest questionnaire.

Year	1976	1977	1978	1979[c]	1980
Total Hunters[a]	1,224	1,318	1,319	1,136	1,383
% Harvest WT Deer	96	88	67	75	76
WT Deer Harvested	594	527	462	458	624
% Antlered Males (WT)	70	81	71	67	69 (55)[d]
% B-tag Antlerless	--	--	--	11	15
Percent Success[b]	53	46	49	54	59

[a] Includes all hunters regardless of species hunted.

[b] Includes all hunters regardless of species harvested.

[c] The size of the hunting district was decreased by a boundary change which excluded a portion of Wibaux County in 1979. Antlerless permits were also issued for Hunting District 750 during 1979-80.

[d] Data in parentheses were obtained for 53 deer examined at check stations during the 1980 deer hunting season.

Table 11. Summary of harvest statistics for hunting district 714 during 1979-80 as determined from statewide deer harvest questionnaires.

Year	1979	1980
Total # Hunters[a]	690	631
% WT Deer in Harvest	65	67
# WT Deer Harvested	160	222
% Antlered Males (WT)	55	67
% B-tag Antlerless WT	26	17
% Hunter Success[b]	37	54

[a] Includes all hunters regardless of species hunted.

[b] Includes all hunters regardless of species harvested.

increased from 1979 to 1980 in hunting district 714 (Table 11). Those hunting seasons were preceeded by winters represented by extremes in winter severity (WSI's of 24,028 and 1,565 in 1978-79 and 1979-80, respectively) which may have influenced harvests somewhat through varying rates of over-winter survival and recruitment. An increase was also noted from the reported harvest in hunting district 714 from 1979 to 1980 (Table 11).

From the statewide deer harvest questionnaire survey, 69% of the reported whitetail harvest in hunting district 750 during 1980 consisted of antlered males. Of deer checked in at Crane and Glendive (from h.d. 750), 55% were antlered males. Swenson (1980) reported similar discrepancies between checking station data and reported harvests of antlered deer throughout Region 7 since 1976. Using an average correction factor of 0.8, an antlered kill of 55% was also determined from the questionnaire data (.69 x 0.8 = .55). Based on this correction factor the estimated harvest of antlered whitetails on the lower Yellowstone averaged 57% from 1976-80.

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Submitted by: Gary L. Dusek

Appendix Table 12. Monthly temperature and precipitation data for Glendive, Savage and Sidney, Montana for the biological year ending 31 May 1981.[a]

	Glendive				Savage				Sidney			
	Temp.		Precip.		Temp.		Precip.		Temp.		Precip.	
Month	Ave.	Dep. Norm.	Tot.	Dep. Norm.	Ave.	Dep. Norm.	Tot.	Dep. Norm.	Ave.	Dep. Norm.	Tot.	Dep. Norm.
June	-	-	-	-	68.2	4.7	1.93	-1.52	66.0	-	1.92	-
July	76.8	2.8	.76	-1.12	74.5	3.7	.58	-1.61	71.0	-	.74	-
August	68.7	-3.5	3.91	2.82	66.1	-3.1	4.42	2.82	65.1	-	2.91	-
September	61.4	1.2	.70	-.35	58.7	1.0	.88	-.36	58.0	-	1.46	-
October	49.9	.5	2.06	1.46	-	-	-	-	47.6	-	1.94	-
November	39.1	6.0	.42	-.01	37.2	6.7	.30	-.11	36.2	-	.49	-
December	22.6	.7	.46	.14	20.4	1.2	.73	.48	19.1	-	.63	-
January	29.8	14.9	.02	-.41	27.4	15.3	.02	-.35	26.6	-	.04	-
February	29.0	8.5	.12	-.23	26.1	7.9	.07	-.23	25.4	-	.20	-
March	41.3	10.9	.34	-.19	38.2	10.3	.15	-.32	38.8	-	.12	-
April	52.0	5.6	.58	-.68	49.6	5.6	.92	-.35	51.0	-	1.09	-
May	59.7	1.9	.97	-.87	58.0	2.8	1.05	-.89	57.8	-	.57	-

[a] Taken from data compiled by U.S. Dept. Comm. (1980, 1981).

Appendix Table 13. Percent composition by age of 28 white-tailed deer harvested in hunting district 714 during 1980.[a]

Age Class	Females (10)	Males (18)	Total (28)
½	20	22	21
1½	40	39	39
2½	30	11	18
3½	10	11	11
4½	--	11	7
5½	--	--	--
6½	--	6	4

6 fawns:22 adults = 27:100
6 fawns:8 adult females = 75:100
yearlings = 57% of adult females
yearlings = 50% of adult males
7 yearling males:4 yearling females = 175:100 or 64% males
7 2½+ males:4 2½+ females = 175:100, or 64% males

[a]Data from checking stations and jaw collections are combined.

Appendix Table 14. Monthly food habits of white-tailed deer in the lower Yellowstone Valley during fall and early winter 1980 as determined from analysis of samples from rumens of 22 deer.

Taxa	September (3)[a]	October (2)	November (13)	December (4)
BROWSE:				
Populus deltoides	100/ 2[b]	50/tr	77/14	75/16
Prunus virginiana	67/tr	-	15/ 2	25/ 2
Rhus trilobata	33/tr	-	23/tr	-
Rosa spp.	100/11	50/ 6	62/ 4	50/tr
Salix spp.	67/31	-	31/ 2	25/tr
Shepherdia argentea	33/ 2	-	15/tr	-
Symphoricarpos spp.	67/ 6	100/28	69/ 9	100/10
Ulmus americana	-	-	15/tr	-
Unidentified Browse	67/ 7	50/ 1	62/ 9	-
Total Browse	100/59	100/35	100/40	100/28
FORBS:				
Aster spp.	67/tr	-	-	25/tr
Cirsium arvense	-	50/tr	23/tr	50/tr
COMPOSITAE	-	50/ 1	-	25/tr
CRUCIFERAE	-	50/ 1	-	25/tr
Glycyrrhiza lepidota	-	-	8/tr	-
Rumex spp.	-	-	8/tr	-
Taraxicum officinale	-	50/tr	15/tr	25/tr
Tragopogon dubius	33/ 2	-	-	-
Unidentified Forbs	100/ 5	50/ 3	54/ 6	100/ 6
Total Forbs	100/ 7	100/ 4	69/ 6	100/ 7
GRASSES:				
Bouteloua gracilis	33/tr	-	-	-
Unidentified Grasses	67/ 6	100/ 5	77/12	100/20
Total Grasses	100/ 6	100/ 5	77/12	100/20
AGRICULTURAL CROPS:				
Alfalfa	100/27	100/40	69/12	50/21
Wheat	33/tr	-	8/tr	-
Barley	-	50/ 4	23/tr	25/tr
Unidentified Cereals	-	-	8/tr	-
Corn	-	-	8/ 4	25/ 1
Pinto Beans	-	-	8/ 1	-
Sugar Beets	33/tr	50/ 9	46/22	100/32
Total Agr. Crops	100/27	100/53	77/39	100/54
OTHER ITEMS:				
Equisetum spp.	-	-	8/ 1	-

[a] Sample size by month is in parentheses.

[b] Percent frequency/percent of monthly diet.

STUDY NO. BG-2.0 JOB NO. 3 (Supplement)

JOB TITLE Successional relationships of riparian vegetation along the lower Yellowstone River.

JOB OBJECTIVE To determine and describe natural plant communities and successional relationships of vegetation along the lower Yellowstone River.

INTRODUCTION

This study was established during the summer of 1980 in conjunction with studies of the population ecology and habitat relationships of white-tailed deer. The study area generally extended along the flood plain and islands of the Yellowstone River from Glendive to Sidney, Montana, with principal emphasis in the vicinity of the Elk Island and Seven Sisters Wildlife Management Areas. Field studies were conducted from July through mid September 1980. Additional field data will be obtained during June-September 1981, with the final thesis report to be submitted as a supplement to the 1981-82 Deer Studies Report. This report briefly outlines study methods and preliminary findings from the 1980 field season.

METHODS

Nine seres, each consisting of 7 stages were located through field reconnaisance. Stages, in order of age from youngest to oldest, were sandbar, seedling, willow, young cottonwood, shrub, and grass. All sampling techniques described below were used in each area (sere) as applicable. All of the seres studied were located in areas relatively free from disturbance by man; agricultural and grazed lands that may possess different successional stages were avoided.

To study successional stages. The stages were objectively sampled by aligning transects perpendicular to the river. The following data were gathered for each stage, age, height of ground above the river level, soil/nutrient composition, species composition, density of all major species, and plant biomass.

The age of each stage was determined by several methods. The largest cottonwood in each stage was singled out. In the seedling and willow stages, the cottonwoods were cut down and the growth rings counted. In the young and old cottonwood stages, ring counts were made from cores obtained with an increment bore.

The height of soil surface above water and soil nutrients were examined for relative age of the soil. Height of soil was determined by measuring the vertical height from river level to the top of the soil, preferrably at a cut bank. Ten samples of the top 10 cm of soil were taken with a soil corer. The MSU soils lab determined total nitrogen and organic matter content of the soil samples.

The density of forbs and grasses was determined by toe-point transects. Three consecutive, 20 point transects were laid out perpendicular to the river in each area sampled. At the end of each transect a plot was established within which all shrubs except willow (*salix* spp.) were counted. Plots varied in size from 2 x 5 meters to 2 x 20 meters. The size of plots was limited to the areas on which 20 total shrubs occurred or a total area of 2 x 20 meters.

A separate plot was set up at the end of each transect to determine densities of cottonwood (*Populus deltoides* Marsh.) and willow. Size of these plots varied between several stages. Small, 1 x 0.5 meter plots, were used in the seedling stage and 2 x 3 meter plots in the willow stage. Plots in the young cottonwood stage were large enough to include twenty trees, those in the old cottonwood stage were the entire length of the transect. Plots in the sandbar, shrub, and grass stages were not necessary because cottonwoods and willows did not occur. Grasses and forbs in five 1 x .5 meter plots were clipped. The five plots were spaced equidistant along the three transect lines. The clipped samples were weighed immediately, separated into grasses and forbs, dried, and weighed again.

RESULTS AND DISCUSSION

Old stream banks subjected to the river's erosional forces, especially during the spring runoff, provided material for sandbars that comprised the first stage of seres. Those sandbars provide the substrate for primary succession. Preliminary observations indicate that cottonwood and willow seedlings do not become established beyond the seedling stage. Willows grow faster than cottonwoods, and soon dominate the stand. Cottonwoods continue to occur but in lower densities. The willow stage persists for 10 to 15 years.

The young cottonwoods gradually grow through the willow and dominate as the willows die out. The young cottonwood stage is characterized by dense stands of cottonwoods with a sparse understory. As the cottonwoods grow larger, their density decreases. When the cottonwoods are between 70 and 140 years old, wood's rose (*Rosa woodsii* Lindl.) and snowberry (*Symphoricarpos occidentalis* Hook.) become the dominant understory shrubs.

Past 140 years, cottonwoods become decadent and die out. Wood's rose and snowberry continue to dominate the understory and form the shrub stage. The length of time the shrub stage persists could not be determined; however, this stage eventually dies out and is replaced by a grass stage consisting mainly of western wheatgrass (*Agropyron smithii* Rydb.) and silver sage (*Artemisia cana* Pursh).

Assuming cottonwood seedlings invade sandbars soon after formation, the age of cottonwood trees is an accurate indicator of the age of the area sampled. All graphs are based on the average age of the cored trees in each stage. I assigned the sandbar stage the base age of zero. The average age of the seedlings was 2 years, the willow stage averaged 8 years, the young cottonwoods 35 years, and the old cottonwoods 100 years. The oldest cottonwood tree cored was 140 years. The ages of shrub and grass stages could not be determined. I have arbitrarily estimated the shrub stage to occur at about 140 years, and the grass stage to follow at about 180 years.

Figure 1 shows cottonwood survivorship. Cottonwoods initially became established in thick stands, over 5000 per 10 x 10 meter plot. By the age of 35 years, density was only 30 trees per 10 x 10 meter plot. At 100 years there was about 1 tree per 10 x 10 meter plot.

The height of the soil above river level increased with stand age (Figure 2). The newly established plants apparently reduced erosion of the silt deposited each year during the spring flood.

Total organic matter and nitrogen increase with the age of the soil. Figure 3 shows that organic matter increased dramatically at first, then leveled out. The total percent soil nitrogen was lower than organic matter, but increased with organic matter. This would be expected because much of the nitrogen comes from organic matter. The increases in height of soil above the river level, total organic matter and nitrogen indicated that the cottonwood derived time scale was correct. There was a noticeable dip in those parameters in the grass stage, but a test indicated that the decrease was not significant at the 99% level when compared to the shrub stage.

The density of *Salix* spp. was high in the seedling stage (Figure 4). By the young cottonwood stage virtually all willows were gone. Wood's rose and snowberry were rare in young cottonwoods, but became common during the old cottonwood stage, and became the dominant plants in the shrub stage. They once again were reduced to low densities during the grass stage, with plants present normally decadent. Silver sage was the dominant shrub in the grass stage.

Grass and forbs wet weight biomass fluctuated between 50 and 120 grams per square meter (Figure 5). During the seedling through shrub stages, total wet weight (grasses and forbs combined, TWW) fluctuated between 50 and 120 grams; in the grass stage increased dramatically to over 200 grams. That increase was due to grasses being the dominant vegetation during that stage. Forbs remained at a constant low level in all stages.

FUTURE STUDIES

Data to be collected next summer include the biomass of trees and shrubs and the ages of additional stands in each successional stage. Other riparian vegetation types important to white-tailed deer will also be identified and described.

Submitted by: Keith W. Boggs

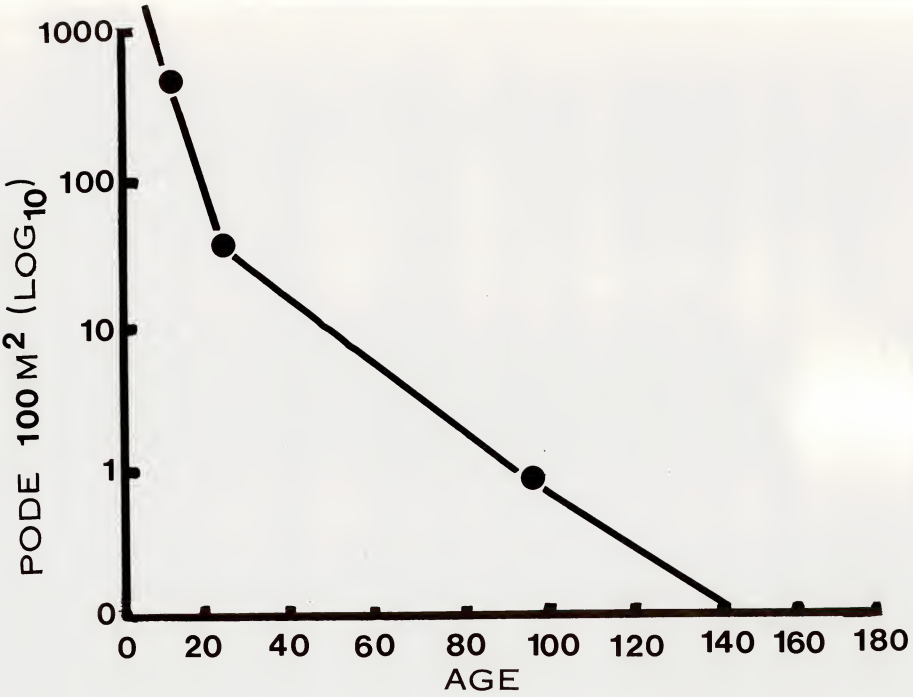

Figure 1. The density of PODE *(Populus deltoides)* per 100 square meters. The seedling density is over 5,000 PODE per 100 square meters. Age is in years.

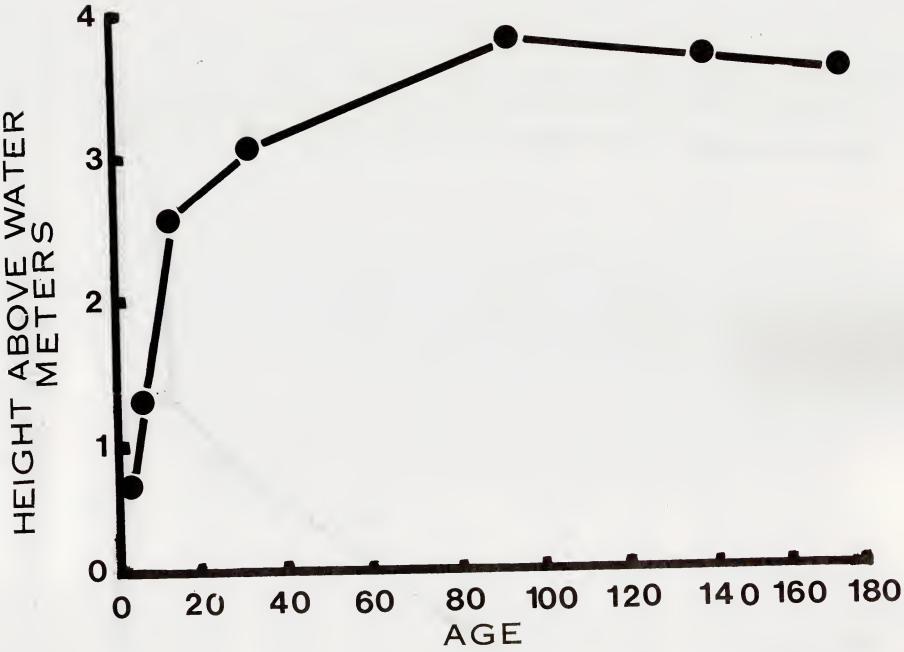

Figure 2. Height of soil above water, measured in meters.

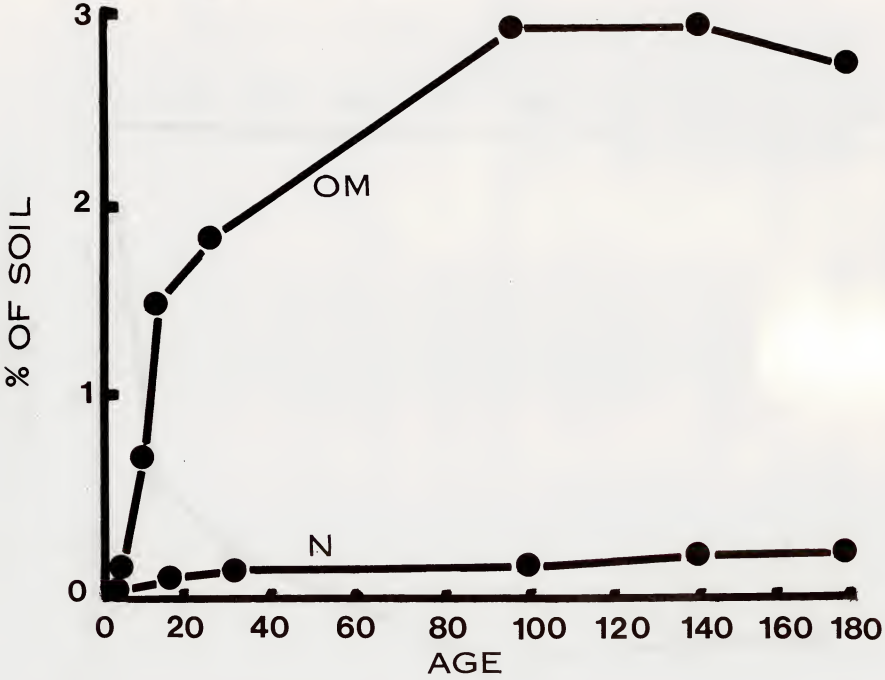

Figure 3. Percent OM (Organic Matter) and N (Nitrogen) in the soil.

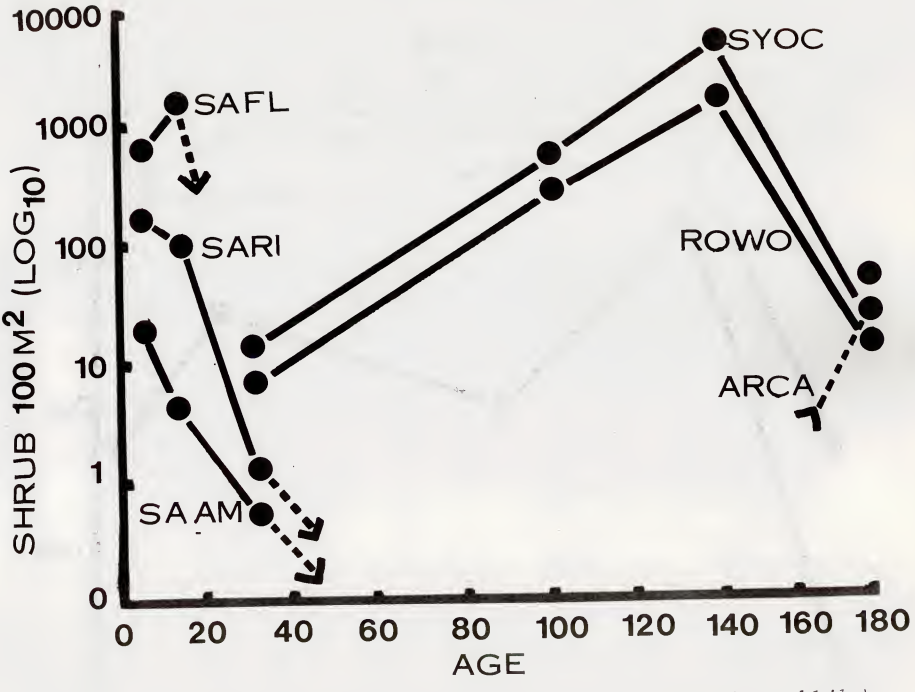

Figure 4. The density of SAFL (*Salix fluviatilis*), SARI (*Salix rigida*), SAAM (*Salix amygadaloides*), SYOC (*Symphoricarpos occidentalis*), ROWO (*Rosa Woodsii*), and ARCA (*Artemisia cana*) per 100 square meters. Dashed lines represent incomplete data.

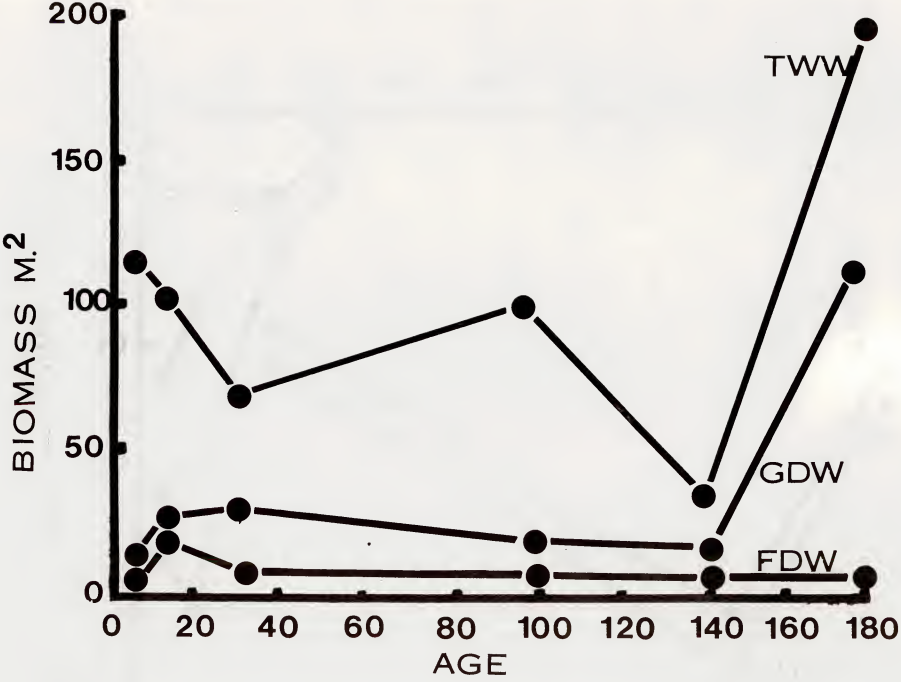

Figure 5. Biomass of grasses and forbs per one square meter. TWN = Total Net Weight (grass plus forbs), GDW = Grass Dry Weight, FDW = Forb Dry Weight.

STUDY NO. BG-2.0 JOB NO. 5

JOB TITLE The relationship of white-tailed deer and mule deer to agriculture in the Gallatin Valley.

JOB OBJECTIVES

1. To determine basic biological and ecological parameters for an erupting population of white-tailed deer in the Gallatin Valley, Montana.

2. To relate those basic population parameters to (2) habitat/environmental characteristics of the Gallatin Valley and (b) specific potential limiting factors for deer in that habitat, including nutrition, other wild ungulates, specifically mule deer, agriculture and associated farming practices, domestic livestock and associated grazing practices, rural subdivisions and associated human activities, weather, disease, and hunting.

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop guidelines for deer management on mountain valley/agricultural habitats.

INTRODUCTION

This project involves study of an erupting population of white-tailed deer in the Gallatin Valley of Montana. Isolated mule deer populations also are found on the agricultural lands of this valley. The mule deer population of the Bridger mountains on the northeastern rim of the valley is also rapidly expanding. Delays in project approval and in obtaining delivery of equipment have postponed the start of the project. The first deer were equipped with radio collars in April 1981. A graduate student has been assigned to the project and field studies are underway.

DESCRIPTION OF STUDY AREA

The Gallatin Valley is an area of about 100 km^2 bounded on the northeast by the Bridger range, the northwest by the Horseshoe Hills, the Madison range on the southwest and the Gallatin range on the south. The valley consists primarily of irrigated fields with more xeric hill areas to the west and north. The major crops are hay, and small grain, with potatoes grown on the western edge. Irrigated pastures are common, with dairies being a major land use. Cattle and horse grazing is also common. The East Gallatin river transects the valley from the east to its confluence with the West Gallatin river in the northwestern portion of the valley. The West Gallatin river crosses the valley along its western side. Numerous tributary streams drain into these rivers. Bozeman, in eastern portion of the valley, is the largest city with Belgrade in the center also being a significant population concentration. At least 90 percent of the 42,821 population of Gallatin County lives in the Gallatin Valley.

METHODS

Helicopter drive nets were used to capture deer. Radio collars were placed on some and Armor-Tite individual recognition collars were placed on the uninstrumented deer.

Deer movements were monitored by fixed wing aircraft and from the ground.

Fixed wing aerial surveys were conducted to obtain distribution information.

Road kill deer were collected and species, sex, age and other information was recorded as appropriate.

A classification of habitat land use types was begun using aerial photos combined with ground truth surveys.

RESULTS

A total of 16 white-tailed deer were trapped. Six of these animals were equipped with radios and the remainder were individually marked with collars. Table 1 details the information concerning these deer.

Table 1. White-tailed deer captured and marked in the Gallatin Valley during March and April 1981.

Area	Sex	Age	Date	Radio Freq.	Collar
Reese Creek	F	2½	3/31/81	151.685(4.4)	White squares on tan
(5080-493)	F	3½	3/31/81	151.763(4-7)	White long stripe on tan
	F	4-5½	3/31/81	151.813(4-9)	White Diag. on tan
	F	fawn	3/31/81	--	Red circles on white
	F	fawn	3/31/81	--	Red long stripe on white
	F	fawn	3/31/81	--	Red B on white
	F	fawn	3/31/81	--	Red triangle on white
Pine Butte	*F	2½	4/13/81	151.714(4-5)	White triangle on tan
(50525-4795)*	F	2½	4/13/81	151.739(4-6)	White H on tan
(50540-4805)	F	3½	4/13/81	151.664(4-3)	White V on tan
	F	fawn	4/13/81	--	White H on green
	*M	4½	4/13/81	--	White V on green
	*F	fawn	4/13/81	--	2 long stripes on green
	M	1½	4/13/81	--	White square on green
	F	1½	4/13/81	--	White M on green
	*M	fawn	4/13/81	--	White circle on green

*

Table 2 summarizes the information concerning road kill deer for years prior to the current study.

Table 2. Numbers and sex and age ratios of road-killed deer examined in the Gallatin Valley from 1976 to April 20, 1981

Year	Species	Number	Males/100 Females	Fawns/100 Females
1976	WT	3	--	--
	MD	3	--	--
1977	MD	1	--	--
1978	WT	13	28.6/100	57.1/100
	MD	26	21.3/100	57.1/100
1979	WT	14	20/100	140/100
	MD	23	44.4/100	111.1/100
1980	WT	21	27/100	63.5/100
	MD	16	0/11	45.5/100
1978-80 Total	WT	48	26.3/100	78.3/100
	MD	65	20.4/100	67.6/100
1981	WT	8	--	--
	MD	7	--	--

Aerial survey data from the current and previous years are presented in Table 3.

Table 3. A summary of aerial survey data for the study area.

Date	Species	Male	Female	Fawn	Unclass.	Total
1976						
9/9	Moose		2			2
1977						
7/27	WT	4	1	1	2	4
8/2	WT	12	25	20	6	63
	MD		11	4	2	17
	Coyote					3
	Pronghorn	2				2
8/11	WT	3	8	7	2	24
	MD	6	2	3		11
	Coyote					5

Table 3. (Cont'd.)

Date	Species	Male	Female	Fawn	Unclass.	Total
1978						
1/5	WT	6	19	7	134	166
	MD				17	17
	Red Fox					1
1/6	WT				24	24
	MD				21	21
	Coyote					1
4/10	WT				102	102
	MD					125
	Elk					4
1979						
1/9	WT				170	170
	MD				26	26
	Coyote					4
	Moose		1	1		2
	Elk					35
	Red Fox					1
1/13	WT	1	10	11	221	242
	MD		1	1	41	43
	Coyote					1
1981						
2/16	WT				27	27
	MD				13	13
2/20	WT				221	221
	MD				2	2
	Coyote					5
3/29	WT				90	90
	MD				49	49
4/4	WT				88	88
	Red Fox					1
4/10	WT				149	149
	Coyote					2
4/18	WT				129	129
	MD					53
5/3	WT				72	72
	MD				4	4
	Elk					7
	Coyote					2
5/9	WT					22
	MD					7
	Coyote					1
5/20	WT					35
	MD					5
	Red Fox					1
5/30	WT					22

On Figures 1, 2 and 3, populations of white-tailed deer or mixed populations of white-tailed and mule deer are shaded in black while populations composed of mainly mule deer are cross-hatched as seen in an isolated area near the center of the valley. The populations along the confluence of the East and West Gallatin rivers, the Storey Hills, and the Pine Butte area are mixed populations of mule deer and white-tailed deer.

The distribution of deer derived from the winter flights (Table 3) is depicted on Figure 1. The summer distribution is depicted on Figure 2 and appears more restricted than that of the winter, which may be a result of the smaller sample size from the summer flights, concealing vegetation, or may be a product of the actual distribution. The data from the spring flights of 1981 are shown on Figure 3. Thirty-three relocations of radio-collared deer were made and are given in Table 4.

Table 4. The relocations of radiobeacon equipped white-tailed deer obtained during the spring of 1981.

Band-Channel	Date	UTM	Band-Channel	Date	UTM
4-4	4/2	60825-4918	4-5	4/18	50545-4815
	4/4	50830-4920		5/3	50545-4845
	4/10	50810-4920		5/9	50456-4812
	5/3	50810-4920		5/20	50542-4816
	5/9	50770-4900	4-6	5/3	50540-4845
	5/20	50804-4934		5/9	50544-4844
	5/30	50805-4933		5/20	50556-4846
4-9	4/4	50816-4934		5/30	50584-4837
	4/10	50816-4934	4-3	4/18	50555-4845
	4/15	50830-4940		5/9	50550-4844
	5/3	50816-4934		5/20	50552-4846
	5/9	50816-4933		5/30	50555-4845
	5/20	50816-4933		6/23	50550-4844
	5/30	50837-4943			
4-7	4/4	50810-4920			
	4/10	50810-4920			
	5/3	50810-4920			
	5/9	50804-4920			
	5/20	50804-4934			
	5/30	50817-4924			

During the early spring, the first green-up occurred on fields of winter wheat and deer utilized these extensively. Distribution did not appear to change much throughout the spring until fawning season approached. At that time greater movements of up to 3 mi were observed. The occurrence of road kills also increased briefly. Those kills consisted mainly of yearlings, especially males. In the Reese Creek area, all three of the radio-collared does moved into the North Cottonwood drainage with the onset of fawning.

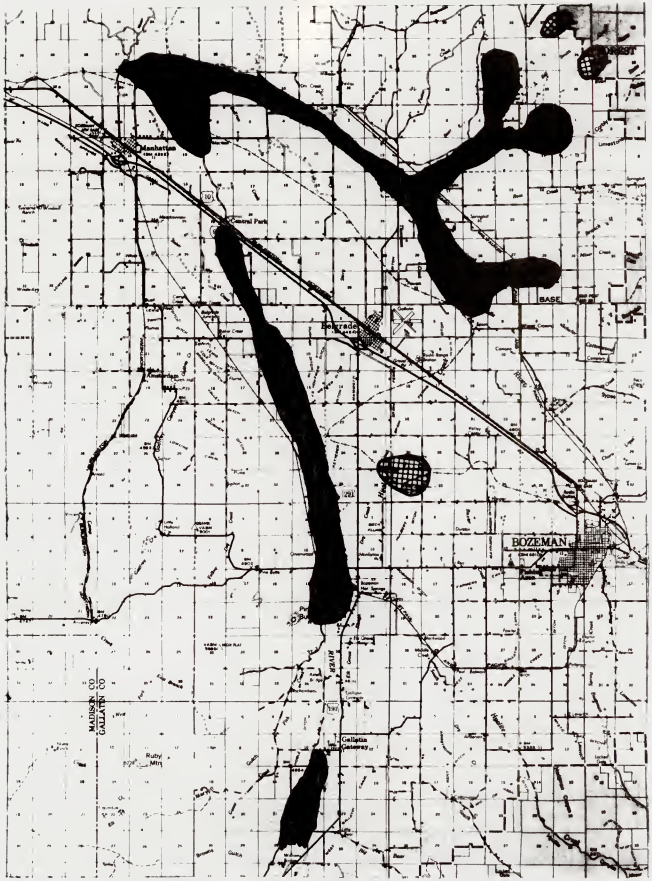

Figure 1. The composite winter distribution of deer observed during aerial surveys of the Gallatin Valley conducted from 1978 to 1981. Solid shading indicates both mule deer and white-tailed deer. Cross-hatched shading shows MD only.

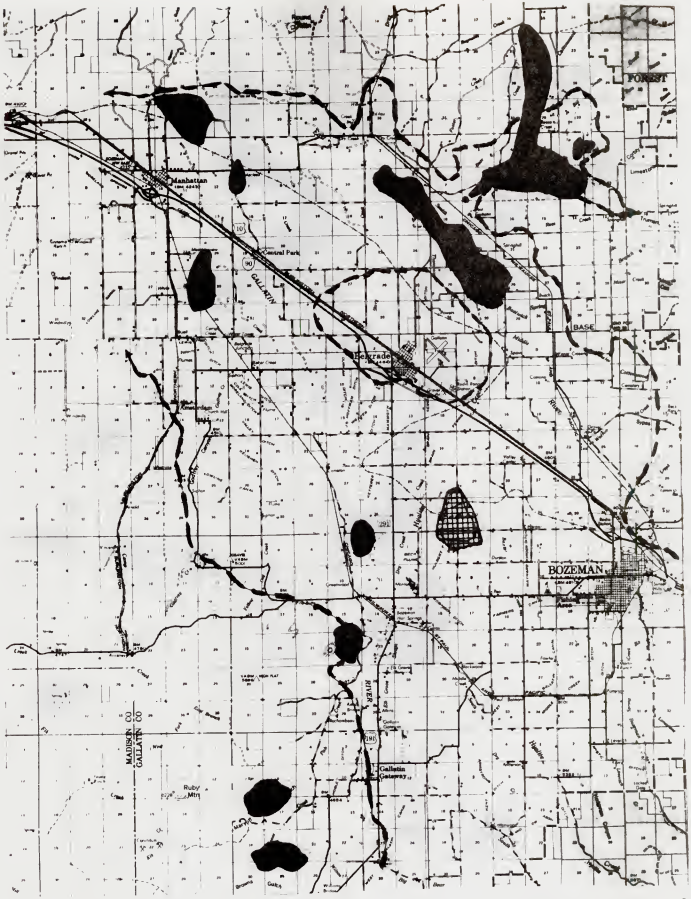

Figure 2. The composite summer distribution of deer observed during aerial surveys of the Gallatin Valley conducted from 1978 to 1981. Solid shading indicates both mule deer and white-tailed deer. Cross-hatching indicates MD only. The broken line indicates the approximate boundary of irrigated lands as observed in Landsat imagery on July 21, 1979.

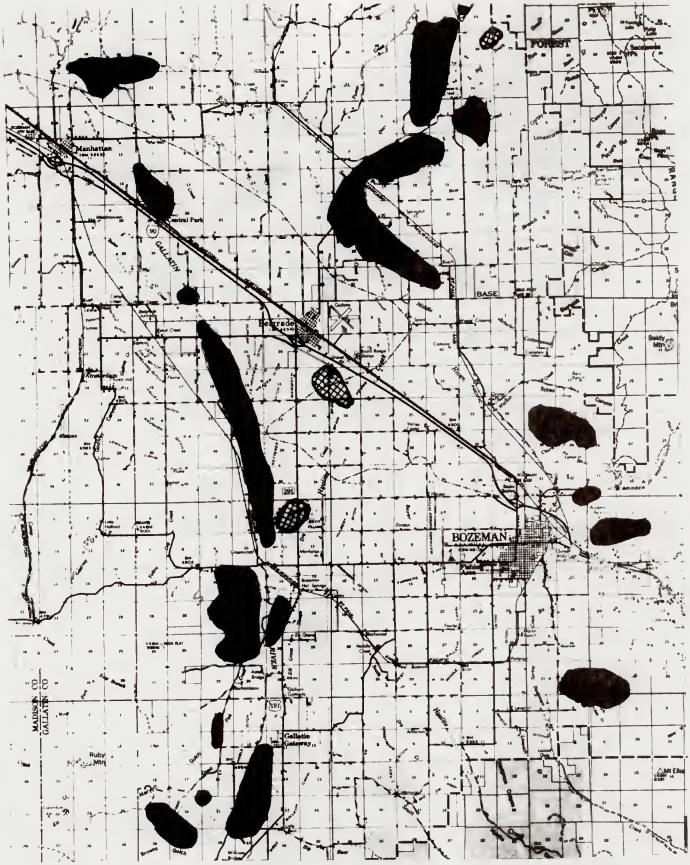

Figure 3. The distribution of deer observed in the Gallatin Valley by aerial survey during April and May 1981. Solid shading indicates areas with both mule deer and white-tailed deer. Cross-hatching indicates MD only.

PLANS AND RECOMMENDATIONS FOR FUTURE STUDIES

1. Radio and non-radio monitering of collared deer will be continued. TELDAY should be used to summarize these data.

2. Additional deer should be trapped and radio-collared, if possible.

3. Aerial and ground surveys should be continued to obtain distribution population size and structure information.

4. Activity data will be obtained for 24 hour periods using a combination of continuous radio monitoring and observation with a passive night vision device.

5. Aerial photographs, and satellite imagery should be used as a base in habitat typing and in obtaining agricultural use data. Satellite imagery will be an aid in monitoring seasonal change.

6. A general system of road routes will be covered at regular intervals and evidence of deer noted. Deer killed along the road system will be collected and recropsied. Other evidences of mortality will be noted.

7. A number of areas of active housing subdivision development will be selected for more frequent monitoring along observation routes.

Submitted by: William Vogel and
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